SPECIFYING THE STRUCTURE OF THE SOYBEAN-MEAT VALUE CHAIN: A TAXONOMICAL APPROACH

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THESIS

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ABSTRACT

As family's income around the world has been increasing in recent years, the demand for chicken meat and pork has been growing. Moreover, this trend is expected to continue in the next decades. In the other hand, world's soybean production is also forecasted to increase at a steady rate in the next decades. Despite that soybean is a crucial primary input in meat production, very often the research found in literature does not consider the complete value chain from soybean to meat production. This approach hinders the possibility to study the interaction between soybean and meat production. This thesis takes an alternative approach and examine the soybean-meat value chain at a global scale. The main purpose of this work was to provide a specification of the soybean-meat value chain, and ultimately explain the soybean-meat relationship at the country level. In this purpose global value chain (GVC) analysis, cluster analysis, and regression analysis were combined into one research methodology that is proposed as a more robust alternative to traditional GVC analysis. The analysis permitted to provide a description of the soybean-meat GVC and to develop a taxonomy of the archetypal value-adding strategies used by countries to produce meat. Different strategies to produce meat were found. In this context, it was evidenced that soybean production is not a necessary nor sufficient condition to produce meat at the country level. Having access (through a GVC) to soybean meal and soybean is then the necessary condition to produce meat. Meat production at the country level was found to be mainly determined by the domestic meat demand.

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1. INTRODUCTION

In microeconomic theory, a good is considered "normal" if the demand for the good increases when income increases. It is widely accepted among researchers that protein from animal origin is a normal good. Meat demand is also considered non-elastic. For instance, Speedy (2003) found that global meat production has increased more than four times since 1960 with wealth as the principal determinant of this increase.

Besides to the income factor, the urbanization process is also regarded as a factor influencing meat demand since an urban worker is not able to produce its food and urbanization is usually related to higher incomes. The United Nations (2014) forecasted the world's urban population in 2050 to be more than six billion. Very high rates of urbanization are expected in Asia and Africa. Furthermore, the natural growth of the world's population will add to the increasing demand for meat (Delgado, Narrod, and Tiongco, 2008).

The evidence in the literature and the economic theory suggest a steady future demand growth for meat as the world income rises and cities grow. For instance, Alexandratos and Bruinsma (2012) in a broad study prepared for the FAO, forecasted global demand for meat to increase more than 55% between 1997 and 2020. Besides, a projection to reach a demand of 374 million tons in 2030 and 455 million tons in 2050 was forecasted.

On the other hand, soybean has been one of the fastest growing crops. The crop experienced an annual rate of growth of 4.5% from 1961 to 2007 (Masuda and Goldsmith, 2009), and it is still forecasted to grow more. Masuda and Goldsmith (2009) forecasted an annual growing rate of 2.2% from 2007 on. In the same paper, a global production of 371 million tons is predicted in 2030.

Soybean is a very versatile raw material and consequently have many industrial uses. However, the use of soybean derivatives -such as soybean meal- in the livestock feeding industry constitutes the largest source of demand for soybean. The question if the growth in the demand for meat is driving the growth of the demand for soybean is a relevant debate topic.

An input-output linkage exists between meat and soybean production. This relationship is depicted in Figure 3, which shows the historical trend of meat and soybean production. However, despite the linkage existing between both industries, very often the research found in the literature look at both industries separately which hinders the possibility to understand the interaction between soybean and meat production.

This thesis work takes an alternative approach and studies the whole value chain from soybean to meat production. By doing so, the understanding of the relationship between soybean and meat can be improved. Looking at the whole value chain, the actual form of the soybean-meat relationship can be studied. Furthermore, the value chain approach contributes to understanding the meat industry's value system and benefit the work of policymakers and investors. For instance, when making investment decisions, forecasting future demand or analyzing new business opportunities.

This thesis intends to contribute to the literature by specifying the structure of the soybean-meat value chain. This analysis contributes to understanding the soybean-meat relationship as the ultimate purpose of this thesis.

In the other hand, the evidence studied suggests that this soybean-meat value chain extends beyond national borders and that a global soybean-meat value chain exists. Meaning this, that production is globally fragmented, and significant world trade exist. International linkages possess a challenge when trying to specify the soybean-meat value chain adequately.

The interaction between countries might mask the linkage between soybean and meat production at the country level.

Bearing in mind the latter, the research work was framed into the global value chain analysis methodology. Bearing in mind the weaknesses of this methodology, this thesis combines global value chain analysis with a quantitative and more robust method such as cluster analysis. By doing so, this thesis additionally intends to contribute to the literature of global value chain analysis by proposing an alternative method of research.

The work in this thesis has implications for both policy makers and investors. As the soybean-meat value chain has been limitedly studied, the dynamism, competitiveness, and heterogeneity of this value chain possess threats and opportunities that may have been underestimated by policy officers and managers. A broader view of the soybean-meat value chain contributes to the design of strategies by countries and firms to advance their participation in this value chain, and to increase the positive economic impact associated with it.

2. LITERATURE REVIEW

2.1 The livestock and soybean industries

Meat is the most valuable livestock product due to its nutritional properties. It is rich in micronutrients and macronutrients, hence an important part of a healthy diet. Meat provides high-quality proteins and contains all the essential amino acids including those that the human body cannot produce by itself. It also provides the human body with minerals, fats, fatty acids and micronutrients such as iron, zinc and vitamin A. Additionally, the bioavailability of these nutrients is higher compared to foods from vegetal origin. (Neumann, et al. 2002)

The FAO Codex Alimentarius define meat as "all parts of an animal that are intended for, or have been judged as safe and suitable for, human consumption". From this standpoint, meat is a broad concept and encompasses several sources. The most common sources of meat are domesticated species such as bovine cattle, ovine cattle, poultry (chicken, duck, turkey, etc.) and pig. Also species such as fish and local sources such as horses, camelids, rodents, etc. Among all these sources, pig and poultry – specifically chickens- excel.

There are economic and cultural reasons that explain the preference towards poultry and pig meat. Magdelaine, Spiess, and Valceschini (2008) propose three causes to explain the consumer preference towards poultry and pig meat. First, the competitiveness of the price of these sources of meat compared to others, second the absence of cultural or religious barriers, and third the dietary and nutritious qualities of this kind of meat. The price of poultry meat in international markets dropped 45% between 1994 and 2002. Only pig meat saw a similar price variation with a price drop of 36% from 1994 to 2003 (Magdelaine et al., 2003). Consumers perceive white meats such as poultry and pig meat as of better quality due to their nutritional properties and positive impacts on health compared to other sources of meat such as red meats.

In terms of consumer preferences, poultry meat sees and advantage over pig meat due to some cultural traditions discourage the consumption of pork.

The competitiveness of poultry and pig meat is the result of the industrialization and intensification process experienced by the poultry and swine industries. The scaling up of the business has allowed to achieve bigger production scales and to perceive the effects on costs due to these economies of scale. This intensification process has been the result of demand factors and technological advances in the production of poultry and pig meat. The next paragraphs summarize the structure and development of poultry and swine industries.

The poultry and swine industry: organization and development

Poultry meat has become the most popular source of animal protein around the world. Within the industry, it is often called the “protein standard” and is present in the diet of many people on a worldwide scale. The modern poultry industry is a complex mixture of technology and logistics that has transformed this type of meat into the most competitive source of animal protein. The evolution of the poultry industry began in the mid-XX century and has transformed poultry meat from a luxury product in its origins to a consumer product nowadays. The following paragraphs consider poultry as chickens since this species is the dominant poultry species and constitutes 90% of the poultry market (Ravindran, 2013).

From the supply side, three factors can describe the accelerated development of the poultry industry. These are the move from a free-range to a confined production system, the improvement in breeding technology, and the improvement in animal disease and mortality control (Narrod and Fuglie, 2000; Boyd, 2001). The move towards a confined operation allowed increasing the number of birds that one farmer could management. This shift permitted the substitution of labor for capital and consequently to increase labor productivity (Narrod and

Pray, 2001). A confined production system also benefited the control of diseases and mortality since animals of different ages could be segregated and raised segregated. The introduction of pharmaceuticals to control diseases has also had positives impacts in the mortality rates of birds in commercial operations (Narrod, Tiongco, and Costales, 2008). The improvements in breeding technology have focused mainly on increasing the output per unit of feed, which is the main input in poultry production. These advances have improved the size of birds, fecundity, growth rate and uniformity. The improvement in breeding techniques has also had positive side effects on disease and mortality control (Narrod and Fuglie, 2000). Birds in commercial productions are significantly larger, achieve their slaughter weight faster and require less feed per unit of weight. For the case of the US, the performance of broilers (young chicken bred to produce meat) since 1925 is shown in Table 1.

The scaling up of the poultry meat production has been a continuous process in recent years. In developed countries, as well in some developing countries, the industry has evolved into an efficient industrial system that ensures meeting the high demand at competitive prices. The modern poultry industry is characterized by a vertical integration, horizontal consolidation, contracted production and regionalization of processing (The Pew Charitable Trust, 2013). These modern large-scale producers are called “integrators” since this type of supply chain is the most common among them. This model refers to the vertical integration characteristic of these producers. Under this model, the raise of the birds is contracted with farmers and the integrator provides them with standardized birds, feeds and medicines. Afterward, farmers sell back the chickens to the integrator at the contracted price. From this point, the integrator is responsible for processing the birds and marketing the finished product. Under this model, the integrator can control the whole supply chain, from the hatching, the production of feed to the commercialization of the finished product. This large-scale, industrialized and integrated model makes possible to perceive significant manufacturing cost reductions due to the achievement of economies of scale and the reduction of transaction costs (Delgado et al., 2008). A synthesized diagram of the process is shown in Figure 1.

This process has proven to be efficient. It became the industry standard in developed countries and some developing ones. Nevertheless, the degree of integration varies among the latter. Many developing regions still maintain artisanal production systems in which small flocks are kept outdoors and are fed homemade feeds composed principally of local crops or household residues. Narrod et al. (2008) found that the move towards industrialization and the level of integration is correlated with the stability of the economy and the growth of urban markets.

Although the previous paragraphs focused in the poultry production, this description could be extended to the swine industry. Despite the particularities of a different species, the modern swine production shares several similarities with poultry production. It is often found that poultry integrators also have swine operations.

Both, poultry and hogs are monogastric species. Monogastric are classified as animals that have a single chamber stomach; this is opposed to ruminant animals, such as bovines and ovines, which their stomachs have several chambers. Ruminants are capable of digesting complex carbohydrates trough the fermentation of fibrous forages that take place in their complex digesting tracts. In contrast to ruminants, poultry and hogs are only able of digesting simple carbohydrates due to the lack of fermentation capacity. Consequently, chickens and hogs require to be fed with an easily digestible good source of protein and amino acids.

Feeding is crucial to producing efficiently poultry and pig meat. Adequate feeding assures the full expression of the genetic potential of the animals and consequently dictates the productivity level of the production. Feed is the single most important input in terms of costs. For instance, in commercial poultry operations, the cost of feed accounts for 65% to 70% of total production costs. About 95% of the total cost of feeding is destined to meet energy and protein requirements (Ravindran, 2013).

The most common efficiency measure in pork and poultry meat production is the feed conversion ratio (FCR) or sometimes referred as feed conversion efficiency (FCE). The FCR measures how much feed is required to produce 1 unit of live mass of the specific species. Considering the weight of feeding costs in poultry meat and pork production, improvements in FCR are translated into more profitability and more competitiveness. For commercial operations, the FCR of chickens is estimated to be 2:1 and the hog FCR is estimated to be 3-4:1.

Maize is the most common source of energy in commercial operations. Nevertheless, due to the high cost of cereals, in many developing countries and semi-commercial operations, maize is substituted by local low-energy alternatives. Meeting the animal's energy requirements with high-energy crops preserves the dietary protein to supply amino acids that have the function of maintaining and growing muscle (Ravindran, 2013). A balanced feed and good quality protein are, therefore, crucial to efficiently produce poultry and hog meat.

Soybean meal: The standard source of protein

Soybean meal (SBM) is considered the best source of supplemental protein in livestock diets. Usually is called the "golden standard" since others sources of protein are compared to soybean meal (Cromwell, 1999). The popularity of SBM as feed to livestock has been increasing. Cromwell (1999) estimated that SBM accounted for 63% of all the protein sources used in commercial animal feeds in 1999. In 2012, SBM accounted for 69% of all the protein sources used in commercial animal feeds. It was followed by rapeseed meal (13%), cottonseed meal (6%) and sunflower meal (5%). The SBM usage percentage varies among countries. For the case of the U.S, SBM accounted for 92% of the total oilseed meals fed to livestock (Cromwell, 2012). The SBM usage by species is shown in Figure 2. Xing and Goldsmith (2013) found that in 2007, commercial feeds for poultry in the U.S had a content of SBM of 27%, and commercial feeds for hogs had one of 19%.

Soybean meal owns its popularity due to its high quality as a supplement in feeding livestock. Soybean meal has a high concentration level of highly digestible protein. Concentration ranges from 44% to 49% depending on the quality of SBM analyzed. SBM also provides essential amino acids that closely match the requirements of monogastric animals such as chickens and hogs (Cromwell, 2012). Soybean meal provides amino acids such as lysine, tryptophan, threonine, isoleucine, and valine. These amino acids cannot be found in other feeder grains such as maize and sorghum; thus, SBM is the ideal balance in the formulation of feeds for monogastric animals.

The availability of lysine is critical since this compound is regarded, respectively, as the first and second limiting amino acid in swine and poultry production (Cromwell, 2012). Despite the higher cost of SBM compared to other sources of protein, the cost-benefit ratio of using SBM makes it the standard in modern commercial poultry and swine operations. The level of SBM usage may be used as a proxy to measure the modernization and scaling-up of the poultry and swine production (Tuan et al., 2004; Xing and Goldsmith, 2013).

SBM is a product of soybean. It is produced from the crushing of raw soybean and using a solvent-extraction process that removes most of the oil contained in the grains. The process continues with the heating of the dry residue. Trough controlled heat; the solvent is eliminated with some other non-beneficial compounds found in soybean such as the Trypsin Inhibitors.

These compounds inhibit Trypsin, which is an important protein-digesting enzyme. Adequate processing of soybean is then necessary to maximize the nutritional potential of SBM. Soybean oil and SBM are coproducts of the processing of soybean.

The fact that soybean oil and SBM are produced simultaneously but meet different demands has implications for the soybean-meat value chain. The soybean oil demand may also affect the spatial organization of the soybean processing and consequently affect the structure of the studied soybean-meat value chain. Nevertheless, to make possible the study of the soybean-meat value chain as proposed, the interaction with soybean oil was not considered in the analysis. This thesis acknowledges this limitation. The analysis of the influence of the soybean oil demand to the soybean-meat value chain is proposed as an additional research topic.

Soybean: A versatile raw material

Soybean (Glycine max) are one of the major crops worldwide. Their value is derived from their versatility as a raw material for several industrial processes. Soybean is composed principally of protein (35%) and edible oil (18%). The processing soybean yields two commercial co-products, namely soybean cake and soybean oil. The oil contained in soybean is mainly marketed as industrial edible oil for human consumption. In recent years, the growing industry of biofuels has been demanding larger quantities of soybean oil as raw material for the production of biodiesel. Due to its high content of proteins, the soybean is also regarded as a nutritious legume that can be consumed by humans or processed into food products. Despite the diverse uses, soybean is mainly processed into soybean cake that is the essential raw material in the livestock industry.

The existence of a linkage between soybean and meat production permits to expand the meat (poultry and hog) value chain to include soybean meal and ultimately soybean. The work in this thesis investigates the complete soybean-meat value chain rather than single stages such as poultry/pork, soybean meal or soybean.

2.2 Value chains

2.2.1 The value chain concept

Michael Porter introduced the concept of value chain in 1985. It refers to the "chain of processes" in which a firm involves to deliver a valuable product or service to the market. In its words, a value chain "disaggregates a firm into its strategically relevant activities to understand the behavior of costs and the existing and potential sources of differentiation" (Porter, 1985). The concept was introduced as a better way to understand competitive advantage since Porter regarded it as more appropriate for this purpose than the idea of value added. Nevertheless, at the industry level the concept of value chain can be understood in another way.

At the industry level, not only a single actor is studied but a group of them. These actors engage in a set of activities aimed to develop, manufacture and market a product. These activities comprise the sourcing of raw materials, the manufacturing of intermediates and the final production and marketing to consumers of a finished product. Bearing in mind the concept of industry value chain, multiple input-output linkages can be established through the process from raw materials to final goods.

2.2.2 The value chain in a globalized economy

Linked activities within a value chain were carried out in close distance to keep the coordination cost low (Arndt and Kierzkowski, 2001). However, in the mid-1990s, the globalization process of the economy, lower trading barriers and advances in transportation permitted the fragmentation of production. Arndt and Kierzkowski (2001) describe fragmented production as organized blocks of production activities that do not require to be done in the proximity. A fragmented production gives the advantage that production activities can be moved around so that the components are produced in the location that offers the best environment (Arndt and Kierzkowski, 2001).

Feenstra (1998) explained the fragmentation process of production as a consequence of the greater integration of world markets. In this sense, the fragmentation of production implied an increase in international trade. This fragmentation process and greater international trade led to the need for an update in the concept of a value chain.

Gereffi introduced the global value chain (formerly called global commodity chain) concept in the mid-1990s based on his work on East Asian manufacturing firms. Later on, various authors continued the development until the global value chain framework was properly introduced in the early 2000s.

The idea of a global value chain refers to the coordination of production activities across geographies. Among several aspects in the industrial organization field, the global value chain concept includes both the idea of commodity chain and value-added chain. In its pure view, the commodity chain is that in which basic agricultural products are grown and marketed. Hopkins and Wallerstein (1986) explained it as “a network of labor and production processes whose ultimate result is a finished commodity”. On the other hand, the value-added chain is “the process by which technology is combined with material and labor inputs, and then processed inputs are assembled, marketed and distributed” (Kogut, 1985).

Considering that value chains are no longer limited to the national boundaries, an improvement in the value chain analysis was necessary. The need to expand the value chain analysis beyond national borders was the motivation for the development of the concept of the global value chain analysis that mainly deals with the analysis of the international distribution of value chains.

2.2.3 Global value chain (GVC) analysis

The global value chain (GVC) analysis refers to the study of globally fragmented value chains. GVC analysis is a research methodology that allows understanding how global industries are organized. It analyses the structure and the dynamics of the different actors participating in the value chain. The method is designed to disaggregate the global configuration of production, trade and consumption of commodities. GVC analysis allows the identification of actors and their geographical division and concentration.

GVC analysis, as originally developed, encompasses four distinct dimensions of analysis. These are (1) input-output structure, (2) geographical consideration, (3) governance structure and (4) institutional context of the value chain (Gereffi and Fernandez-Stark, 2011). Later on, Humphrey and Schmitz (2002) developed an additional fifth dimension that focus on the analysis of value addition; this is the so-called "upgrading" dimension. These five dimensions of analysis are the basis for the GVC analysis methodology. Each of those is detailed in the following paragraphs in concordance with the work of Gereffi and Fernandez-Stark (2011).

Input-Output structure

Different actors within a value chain can be linked together based on the outputs generated and the inputs demanded. The input-output relationships are what constitute the structure of the value chain. Consequently, identifying and describing these relationships permits to discover the pattern of the value chain. The results of the input-output analysis are synthesized into diagrams of flow. The role of the researcher is to link the pieces of information and to create a "united and self-explanatory chain that includes the principal activities of the industry". The chain then can be divided into segments that illustrate the transformation and the value adding processes along the value chain. The next step is to study the specific characteristics and the dynamics of each of the segments of the value chain. To accomplish this purpose is necessary to study the evolution of the industry, the trends and its organization.

Geographical consideration

Due to the fragmentation of production, the value-adding stages of a value chain are often globally dispersed. Different activities of the same value chain can be carried out in various countries. In a globalized economy, countries participate in global value chains by leveraging their competitive and comparative advantages. The contributions of different countries can be examined through the analysis of country level data such as exports figures and the segments in which those exports are concentrated. The analysis of the geographic scope of value chains has permitted to map shifts in the geographical configuration of global value chains. This field of study continues since global value chains have a dynamic nature.

Governance structure

Governance is defined as the "authority and power relationships that determine how financial, material and human resources are allocated and flow within a value chain" (Gereffi and Korzeniewicz, 1994). The analysis of governance permits to understand how the chain is controlled and coordinated based on the power relationships between value chain's actors. Understanding the governance of a value chain may facilitate explaining the input-output structure and the geographical distribution of the value chain. In this sense, the governance analysis may help to outline the future development of the value chain structure. Understanding how the value chain is controlled, facilitates successful entry of new actors or further development of current actors within the value chain.

Originally, governance was described only in terms of “buyer-driven” or “producer-driven” chains (Gereffi and Korzeniewicz, 1994). Buyer-driven structures are those in which large retailers dictate the standards and protocols that suppliers have to meet. In contrast, producer-driven structures are those in which the power is exercised by vertically integrated producers, which leverage on their technological or scale of production advantages. Five additional governance structures are developed in the literature; these are market, modular, relational, captive, and hierarchy. In practice, simultaneous governance structures may be identified within global value chains.

The governance structure responds to three variables: Complexity of transactions, how the information for production can be codified, and the level of supplier competence (Gereffi and Fernandez-Stark, 2011). In turn, the governance structuring variables are related to technology, information (complexity and codification), and the ability of suppliers to learn (Keane, 2008).

Institutional context

The analysis of the institutional context identifies how policies, the local, national and international environment affect the level of globalization in each of the value-adding stages of the global value chain. Each actor of the value chain is affected by the local conditions of their location. These conditions may be of an economic, social or institutional order. Examples of these conditioning variables are the availability of inputs, labor cost, infrastructure, taxes, subsidies and other policies. The insertion of a country or firm in the global value chain is constrained by these limiting variables (Gereffi and Fernandez-Stark, 2011).

The previous four dimensions can be divided into two groups, value chain mapping and value chain analysis. This procedure is known as the two-part GVC research approach (Frederick, 2014). The first two dimensions seek to describe the structure of the value chain, and the second two to explain why such structure exists. The last dimension, more recently developed, is aimed to understand the dynamics of actors within the structure mapped.

Upgrading

Gereffi (2005) defines upgrading as the process in which "firms, countries or regions move to higher value activities in global value chains in order to increase the benefits from participating in global production". The current position of an actor in a value chain and the upgrading process are linked to a series of economic roles and capabilities. This upgrading process responds to a diverse mix of government policies, institutions, strategies, technologies and resources proper of each value chain structure and the local institutional context. Four upgrading strategies can be identified; these are process upgrading, product upgrading, functional upgrading and chain or inter-sectoral upgrading.

Process upgrading refers to the increase in efficiency when transforming inputs into outputs. Process upgrading often involves the introduction of superior technology. Upgrading the product connotes moving into a more sophisticated one. Functional upgrading denotes increasing the complexity of the activities carried out in the value chain. Lastly, inter-sectoral upgrading is the transition to new (although related) industries.

2.2.4 Agri-food global value chain analysis

Global value chain analysis was first developed to understand the globalization phenomenon in manufacturing. Originally global value chain analysis focused in analyzing the international role of transnational manufacturing firms and their role in the increasing globalization of the economy. For instance, the original work of Gereffi (1994) was based on the case of garment manufacturing firms expanding in East Asia.

Similar to other fields, the research in agri-food global value chains has focused on the disclosure of the linkages between the value chain actors and the structure of power that governs these linkages. Humphrey and Memedovic (2006) identified two research trends in the field of agri-food value chain analysis. These are the study of the implications of food safety standards, and the study of the concentration of power along the value chain.

A common characteristic of the research in the food safety field is to assess how food safety standards shape the structure of agri-food value chains. Henson and Reardon (2005) provided a comprehensive review of the evolution and nature of food safety and quality standards. The work included the analysis of the impacts of these standards on the structure of agri-food value chains. It also studied the strategy adopted by firms in these value chains. In subsequent works, Gereffi and Lee (2009) employed GVC analysis to examine the impact of new food safety standards in the structure of agri-food value chains. Gereffi et al. (2008) also used GVC analysis in order to evaluate the level to which the structure of agri-food value chains determine the type of food products offered to consumers and the health issues associated.

A common objective of the research in the field of power concentration is to evaluate how this power concentration shapes the structure of the value chain. The ultimate goal is to assess the role and competitiveness of actors (firms or countries) of the value chain given the existence of certain governance structures that are product of the power exerted by other actors of the value chain. For instance, Roldán-Pérez et al. (2009) employed GVC analysis in order to evaluate the state of the value chain of coffee in Colombia and Vietnam. The results permitted an evaluation of the competitiveness of the local coffee industries in the international market. It also allowed identifying several barriers to entry and rent product of dominant positions of actors within the value chain of coffee. Tinsley (2009) conducted a value chain analysis of the soybean value chain in Malawi and Kenya in order to develop strategies to expand the soybean production of small-scale farmers. Davids et al. (2013) also used value chain analysis in order to assess the competitiveness of the South African pork value chain.

Similar to the research in other food products, the literature found about the meat value chain can be divided into two broad categories. First, the study of the concentration and governance structure of the value chain; and second, the study of the specification of the structure and competitiveness of actors of the value chain. A common characteristic of studies in both categories is that the research is frequently conducted in a single country. Rarely the research involves several countries simultaneously.

The primary objective of the research in the first category is the analysis of the increasing power of the so-called “integrators” as they were described in section 2.1. Gereffi et al. (2008), provides a specification of the value chain of poultry in the U.S. The study concludes that the success of the leading firms in the value chain is the result of the ability of these firms to combine advantages of multiple forms of industrial governance. This study only focuses on the value chain of poultry from the hatchery to marketing and does not deepen into other segments of the poultry value chain such as feeding. Similarly to this paper, Lowe and Gereffi (2008), worked on a value chain analysis of the beef value chain in the U.S. The authors focused the analysis on the issue of product traceability. The main finding is the increasing verticalization and coordination by big players, both in the supply and the demand side. Manning and Baines (2004) also worked on the poultry value chain and looked at the key factors that have led to the globalization of the poultry value chain. The main finding is the key role of multinationals firms in the globalization of the poultry value chain. Despite the author expanded the analysis to a global level, it was conducted with world-aggregated figures. It did not provide and analysis of the links at the country level. An additional shortcoming is that the analysis is mainly anecdotal.

The research in the category of the value chain specification and competitiveness analysis, regularly focus in emergent countries. One common objective is to review the technological development of the value chain compared to the technological standard of developed nations. Fabiosa and Fang (2005) worked on the Chinese pork value chain and focused on the analysis of the drivers of the transformation towards commercial hog production in China. This paper also assess the potential competitive advantage of Chinese producers in a scenario of increased foreign trade. Similarly, Chendong et al. (2014) worked on the analysis of the Chinese poultry value chain. The primary research objective was the analysis of the rapid industrialization of the poultry industry in China. In both cases, no linkages to the feeding stages of the value chain were considered. Okello et al. (2010) and Davids et al. (2013) used value chain analysis to study the poultry value chain in Kenia and the pork value chain in South African respectively. The objective of both studies was to specify the structure of the value chain. The former focused the research on the identification of potential entry pathways of diseases in the value chain while the latter focused on evaluating the competitiveness of the value chain.

Surprisingly, seen as a value chain, soybean has been less studied. One common area of research is the study of soybean from a cash crop point of view. The objective is regularly to analyze the potential of a highly demanded and versatile crop such as soybean in poverty reduction in poor countries. Besides to the already mentioned work of Tinsley (2009) (2), Kapuya et al. (2010) employed value chain analysis to evaluate the soybean value chain in

Zimbabwe. The study focused on the analysis of the policy requirements necessary to enhance intra-regional trade in order to expand the value and volume of the local production.

An alternative area of research in the field of soybean value chain exist. When the industrial applications of soybean are considered, a broader approach to the cash crop approach may be followed. This alternative approach is the so-called “soybean complex” approach. This approach acknowledges the role of soybean as a generator of further industrial development and establishes linkages with subsectors such as soybean oil and soybean meal. Goldsmith and Hirsch (2006), is one of the few papers that explicitly acknowledge the linkage between soybean and meat. One of the contributions of this paper is the introduction of the construct of soybean demand as a derived demand for meat.

The literature in meat and soybean value chain reviewed revealed two main shortcomings. First, the research mainly focuses on a single stage of the whole value chain. For instance, the papers looking at the poultry value chain that were reviewed concentrate on the value chain from hatching to retail, and do not consider previous stages of the value chain such as SBM and soybean. Second, the value chain analysis is usually narrow in geographical scope as it is restricted to a single country. As stated earlier, there is evidence that suggests that there is a global value chain of poultry and hog meat in which international linkages can be found. A single country analysis might not be sufficient to understand the dynamism and heterogeneity of the value chain, and consequently to correctly assess the opportunities and challenges within the value chain.

Summing up, the literature review about the research of the soybean and livestock industries revealed the following. First, regularly the soybean and livestock industries are treated separately, and the research avoids the consideration of the value chain. Second, when a value chain approach is followed, again, the research focus in the intra-segment (either livestock or soybean industry) value chain rather than in the complete value chain going from soybean to meat. Third, the research is usually geographically narrow. Fourth, the research rarely includes quantitative data.

Bearing in mind the latter shortcomings, the work in this thesis considers the complete value chain from soybean to meat at the country level and with a global scope. In this purpose, soybean production, soybean meal production and meat production were understood as different value-adding stages of the same value chain. By doing so, this thesis aims to contribute to the literature by providing a specification of the structure of the global soybean-meat value chain. The ultimate objective is to understand the structure, the dynamics and the heterogeneity of the soybean-meat GVC, which enables to explain the linkage between soybean and meat production.

The GVC methodology permitted to study the structure and dynamics of the soybean-meat value chain. Following the GVC methodological structure described earlier, the following specific objectives were proposed in order to study the input-output structure, to assess the geographical consideration and the institutional context.

1. To map the input-output structure of the global soybean-meat value chain
2. To analyze the international linkages among actors of the soybean-meat value chain and the resulting international trade configuration
3. To assess the way in which the institutional context shapes the soybean-meat value chain
4. To review the state and recent trends within the meat-soybean value chain

The GVC analysis methodology was chosen for this work since it is designed to disaggregate the global configuration of production, trade and consumption of commodities that permits to study a global value chain correctly. Nevertheless, some considerations to this methodology are worth to note. First, GVC analysis is usually conducted at the firm level. At this level, doing an input-output analysis is costly and time consuming. For this reason, GVC analysis often relays on a sample of just a couple of leading firms. For the same reason, GVC frequently focuses on using a single country as an example of the whole global value chain. Furthermore, at the firm level is difficult to find abundant quantitative data, in consequence the GVC analysis takes an anecdotal case study approach that may be prone to subjective conclusions.

To overcome the described shortcomings, this thesis propose some improvements. First, to work with country-level aggregated data, and second to combine GVC analysis with a more robust and quantitative tool such as cluster analysis. This alternative will benefit the analysis since a larger sample of countries can be considered, and the analysis can incorporate quantitative data available at the country level. The cluster analysis technique is a helpful resource to treat the heterogeneity that arises when several countries are included in the sample.

2.3 Cluster analysis (CA)

Cluster analysis is an empirical classification method. Cluster analysis "groups data objects based only on information found in the data that describes the objects and their relationships" (Tan, Steinbach and Kumar, 2006). The ultimate goal of cluster analysis is to form groups or clusters of similar objects. Objects within a cluster are similar to each other but different to objects in other clusters. The quantitative problem of clustering analysis is to minimize the "distance" between objects of the same cluster and to maximize the distance between objects in different clusters. The set of these "distances" are compiled in a proximity matrix that is the only input for a clustering process (Jain and Dubes, 1988).

The clustering processes can be divided into two categories. These are exclusive and non-exclusive. The division is based on the flexibility of cluster membership. An exclusive clustering process is a partition in which each object of the set belongs exclusively to one subset or cluster. In the other hand, in a non-exclusive clustering process objects can belong to more than one cluster. Non-exclusive methods are referred in the literature as fuzzy clustering.

The clustering process is performed through a clustering algorithm. These are the rules or procedures to sort the objects and merge them into clusters. In the case of exclusive clustering, clustering algorithms can be divided into two classes. These are hierarchical and non-hierarchical. The distinction is made upon the structure imposed on data. A hierarchical clustering process is a nested sequence of partitions, instead of a single partition as it occurs in the case of non-hierarchical clustering. Hierarchical clustering is useful in fields such as taxonomy since taxonomy requires a hierarchical structure in which each object is nested into the next one. Hierarchical clustering is shown graphically using dendrograms, which is a particular type of tree structure that consists of layers of nodes each representing a cluster (Jain and Dubes, 1988).

Hierarchical algorithms

Hierarchical algorithms are divided into two different categories based on the procedure to create the hierarchy. These two categories are the agglomerative and the divisive clustering. Agglomerative algorithms start with objects representing individual clusters. At each iteration, the algorithm merges the closest clusters until all of the objects are part of one single cluster. The divisive approach takes the inverse direction as it starts with all of the objects belonging to one single cluster and gradually divide the objects into smaller clusters. In general, the outcome is the same. Thus, the approach selected is more a choice of procedure (Jain and Dubes, 1988). Nevertheless, in the study of social sciences the use of divisive algorithms is rare (Ketchen and Shook, 1996).

As described by Tan et al. (2006), the procedure of an agglomerative algorithm is as follows. The first step is to compute the proximity matrix, and then, the two closest clusters are merged, next the proximity matrix is updated, and the next closest clusters are merged. This process continues until all of the objects are merged into one single cluster.

The critic step in a clustering algorithm is to compute the proximity matrix, which compiles the information of the proximity between clusters. In order to accomplish this, two variables need to be taken into account; these are the proximity index and the linkage criteria.

The proximity index can be explained as a measure of the “distance” between two selected points. The linkage criteria refer to what criteria to choose in order to calculate the proximity index between clusters (i.e. the closest two points between clusters, the farthest, etc.)

Several proximity indexes exist; the most common are the Euclidian distance (ED), the Manhattan distance, the Maximum distance and the Mahalanobis distance (MD). The most common proximity index used is the Euclidian distance that is appropriate for uncorrelated variables with equal variances. The Euclidian distance is computed as follows:

$$ED = \sqrt{\sum_{i} (a_i + b_i)^2}$$

The Mahalanobis distance (MD) is an alternative proximity index. Different from the Euclidian distance, the MD calculates a probabilistic distance. The distance between two points is measured in standard deviations from the mean (of the whole set of objects) rather than in absolute values between the two points. The main advantages of the MD are that it is unitless, scale-invariant, and take into account correlations of the data set. If the dataset is standardized to have zero mean and unit standard deviation then, MD and ED are equivalent.

Hierarchical algorithms can be subdivided based on the linkage criteria to use. The five most common hierarchical algorithms are the single linkage, the complete linkage, the average linkage, the centroid method and the Ward's method.

The single linkage defines proximity between clusters as "the distance between the closest two points that are in different clusters". The single linkage is suitable to handle non-elliptical shapes but is sensitive to noise and outliers (Tan et al., 2006).

The complete linkage defines proximity between clusters as "the maximum distance between any two points in two different clusters". Is less susceptible to noise and outliers, it can break large clusters and favors globular shapes (Tan et al., 2006).

The average linkage is a combination of the two previous approaches. It defines proximity as the "average pairwise" distance "among all pairs of points in the different clusters" (Tan et al., 2006).

The Ward's method defines proximity as "the increase in the squared error that results when two clusters are merged" (Tan et al., 2006). It tends to produce clusters with the same number of objects and is very sensitive to outliers (Ketchen and Shook, 1996). The centroid method uses the centroids of the clusters to compute the proximity. It takes the distance between centroids of two different clusters. It tends to produce cluster with irregular shapes (Ketchen and Shook, 1996). Except for the centroid method, for all of the hierarchical methods the distance between clusters "monotonically increases" during the agglomeration process (Tan et al., 2006). This characteristic can be seen as a disadvantage since a new proximity matrix can be less effective than a previous one in terms of correctly agglomerate the objects.

The centroid, the Ward's, and the average linkages methods are affected by the size of the cluster to be merged. Typically, the size will differ. Based on this, two approaches to executing the algorithms can be taken. These are, the weighted approach (which treats all cluster equal), and unweighted approach (which considers the number of objects in each cluster).

Non-hierarchical algorithms

Non-hierarchical algorithms are iterative algorithms that divide (only once) the data into a pre-specified number of clusters. The first step in the algorithm is to define the number of points within the data set that will serve as initial centroids. These centroids will represent the number of clusters to form. Then, each of the objects is assigned to the closest centroid. Next, the centroids are recalculated based on the objects grouped, and the objects are re-assigned to the new nearest centroid. This process continues until no object changes its cluster membership.

The previous algorithm corresponds to the K-means algorithm, which is the general form of the non-hierarchical algorithms. Some variations exist based on the form the centroid is calculated. The K-medoid algorithm uses medoids instead of means to calculate the centroids. A medoid is the most central object of a cluster. If the median is used instead of the means, then the algorithm becomes the K-median algorithm. This algorithm is more suitable for discrete or binary data since it uses the Manhattan distance proximity index as a measure of distance. K-means and K-medoids commonly use the Euclidian distance (squared) as proximity index; this makes them more suitable for continuous data.

A downside of using the Euclidian distance (squared Euclidian) as proximity index is that outliers influence the conformation of clusters strongly. For this reason, the K-medoids algorithm is very sensitive to the presence of outliers. The K-mean algorithm is weak when trying to find “natural” clusters when clusters have non-spherical shapes, different sizes or densities. The usual approach to strengthening this weakness is to use a large number of cluster. Nevertheless, this will depend on the objective of the study. In the other hand, K-means is a simple algorithm yet very efficient since it performs several runs over the data. Hierarchical algorithms, instead only make a single run.

Issues in the cluster analysis practice

The effectiveness of cluster analysis depends on several variables that researchers need to address adequately. There are three main issues that need to be taken into account; these are clustering variables, clustering algorithms and determining the number of clusters to form.

Choosing the correct clustering variables is the most important step. The election of the right variables involves the definition of variables, the standardization of variables and the addressing multicollinearity among variables.

The definition of the clustering variables can take three different approaches based on the incorporation of theoretical background in order to make the election. When the theory is used to define the variables that will define the cluster, the approach is called deductive. The goal is to use theory to incorporate only variables that have a theoretical predictability of the phenomenon analyzed.

The inductive and the cognitive approaches are similar in that both do not rely on theory to select the clustering variables. Very often, a cluster analysis is an exploratory analysis, then the inductive approach suggests to incorporate as many variables as possible in order to increase the likelihood of finding unknown patrons within the data. The cognitive approach base the selection of variables on the perception of experts rather than on the researcher's own perception as is the case of the inductive approach.

Ketchen and Shook (1996), suggest choosing the "correct" approach to select the clustering variables based on the purpose of the study to conduct. This meaning, the explaining or exploratory purpose of the study. If deduction is the objective of the research, then is advisable to choose variables based on their theoretical predictability.

Due to the mathematical procedure used by cluster analysis, the differences in scale and units among variables may cause that a subgroup of clustering variables dominate the clustering process leading to biased results. Standardization of the data corrects this bias. Nevertheless, this solution can have side effects since the standardization can prevent from finding natural patterns in the data (which is the purpose of cluster analysis). Ketchen and Shook (1996) recommend conducting the clustering twice. First using standardized variables and then non-standardized variables. The most meaningful solution is the one to be chosen.

Another issue is the collinearity among clustering variables that may cause to overweight some underlying patterns. In order to weight evenly the potential patterns underlying the cluster analysis, multicollinearity must be corrected. A simple way to address this, as explained before, is to use the Mahalanobis distance as proximity index. MD simultaneously standardize variables and treats high correlation. If standardization creates an unwanted side effect, multicollinearity can be addressed through factor analysis. Ketchen and Shook (1996) suggest doing the analysis multiple times changing the approach to address multicollinearity and make a decision based on the consistency of the results.

As detailed before, each clustering algorithm has its advantages and disadvantages. The election of the algorithm should match the type of data that is being analyzed and the clustering results that are expected. Ketchen and Shook (1996) suggest using hierarchical and non-hierarchical methods in tandem in order to increase the efficacy.

Finally, the last issue is to determine the number of clusters to form. The general rule is that this decision is based on the researcher's experience and expectations. Various technical approaches also exist in literature. When applying a hierarchical algorithm, the simplest way is to inspect the dendrogram and visually find the "optimal" number of clusters. The most effective quantitative decision rules found in the literature are the Calinsky-Harabasz index and the Duda-Hart Index. The rule of thumb is to select the solution with the number of clusters that gives the highest value of the Calinsky index. The Duda-Hart index computes two values; these are the Je(2)/Je(1) and the pseudo T-square. The rule of thumb is to select the number of clusters producing one of the largest Je(2)/Je(1) values and that also match a low pseudo T-square value that has a much greater pseudo T-square value next to it.

2.4 The GVC-CA analysis: An alternative method

An additional contribution intended by this thesis is the proposal of an alternative method to conduct global value chain analysis. The GVC-CA method that is proposed builds on the benefits and advantages of traditional GVC analysis and empirical clustering. Combining both techniques into one methodology benefits the analysis of the global value chain at the country level and with a worldwide scope.

As described earlier, the traditional GVC analysis permitted to study the structure and dynamics of the soybean-meat value chain. The motivation to adding up a cluster analysis was to examine the heterogeneity of the soybean-meat value chain observed after conducting the traditional GVC analysis on a large multi-country sample correctly.

The observed heterogeneity can be understood as the differences existing between clusters of similar actors (countries) participating in the global soybean-meat value chain. Considering the latter, the behavior of actors within a cluster could be summarized into one archetypal profile representative of the whole cluster. In this sense, the objective in the CA section was to develop a taxonomy of the different archetypes of actors in the value chain. This taxonomy covered two dimensions. First, a segmentation of the meat market at the country level. This segmentation was based on the preference (taste) for either poultry or pork and the source of the domestic supply of meat. Meaning either local production or imported. Second, a taxonomy of the archetypal behaviors of the actors (countries) within the value chain. The goal of this second part was to classify countries based on their role (i.e., producer, exporter, importer, and trader) at each stage of the value chain. Also to classify the value-adding strategies followed by countries in order to produce meat locally. In concordance, the following specific objectives were proposed.

5. To segment meat demand based on the preference for either poultry or hog meat
6. To segment meat supply based on the sourcing profiles (local or imported)
7. To develop a taxonomy of the archetypal roles of actors at each stage of the value chain of meat
8. To develop a taxonomy of the archetypal value adding strategies followed by actors of the value chain

Different from what is found in the literature, this thesis intended to expand the study of the soybean-meat value chain by analyzing not a single country, but rather a larger multi-country sample. The taxonomy of archetypes that was developed contributed to synthesizing the heterogeneity found in this multi-country sample. Understanding the archetypes was a necessary step in the ultimate purpose of explaining the relationship between soybean and meat production. Since this soybean-meat relationship was hypothesized to be embedded into a global network, the study of the value adding strategy archetypes revealed the different forms of the relationship soybean-meat that exist within this global network.

The last step in the analysis of the soybean-meat relationship was to measure the linkages between stages of the soybean-meat value chain empirically. The objective was to estimate the determinants of the domestic production of meat, SBM and soybean at the country level. In this purpose, a regression analysis was employed to estimate the relationship between the three stages of the value chain.

By combining the findings obtained from the GVC-CA analysis with the empirical results obtained from the regression analysis it was possible to propose an explanation for the soybean-meat relationship. In concordance, an additional specific objective was proposed.

9. To measure the determinants of the domestic production of meat

3. DATA AND METHODS

3.1 Data

The main critique of GVC analysis is the data sources on which it relays. Often, the GVC research methodology tends to be prone to subjective analysis because rarely GVC analysis incorporates quantitative indicators (Frederick, 2014). Very often GVC analysis is conducted at the firm level, at which is difficult to find adequate quantitative data. Consequently, researchers following the GVC methodology have to gather information from survey data, interviews, and secondary sources found in the literature. Then follow a case study approach. Nevertheless, when working at the country level, the options to acquire quantitative data are broader. Country-aggregated input-output matrixes and international trade figures are compiled by organizations such as the OECD, The World Bank, and the World Trade Organization.

Agri-food research, at the country level, and with a global scope, possesses an additional challenge in terms of building a reliable and comprehensive data set. This challenge is a consequence of variable availability quality of data across the different countries studied. The primary source of data is the official national figures reported by a country. These data are compiled by organizations such as the FAO, the OECD, The World Trade Organization, The World Bank, and the Agricultural Market Information System (AMIS). Far from perfect, these data sets suffer from the heterogeneous standards and capabilities of each country's agricultural information system.

The adequate data set must be comprehensive in time, commodities, and countries covered. It also has to maintain a standard methodology for estimations. The data sets disseminated by the FAO's statistical division (FAOSTAT) meet these characteristics. Other sources considered such as AMIS, and the OECD statistical service are limited in terms of the variables collected and the geographical areas covered. Bearing in mind these limitations, the use of the FAOSTAT data sets was more suitable. Despite its limitations, several researchers in the field of agricultural economics have used the FAOSTAT data sets (Masuda and Goldsmith, 2009).

The FAOSTAT website offers data sets covering several domains including production, trade, food balances, population, and land since 1961 to 2011. A database was constructed using FAOSTAT data from 1997 to 2011 for 178 countries. During this period, three new reporting jurisdictions emerged; these were The Netherlands Antilles, Luxembourg, and Montenegro. In order to maintain a continuous basis of analysis, the data reported by these new jurisdictions were aggregated with their original political division, this is respectively: The Netherlands, Belgium, and Serbia.

A database for pork, poultry meat, soybean meal, and soybean was constructed at the country level. The variables included were domestic production, domestic supply, imports, exports, stocks and for the case of soybean, local processing. All the previous variables were measured in tons per year. Is worth to note that the FAOSTAT data sets permit to differentiate between SBM for feed and other uses. In consequence, the database constructed included the figures most suitable for the study. Meaning, SBM produced for feed.

Besides the variables listed above, socio-economic variables were collected for each country. These variables were: urban and rural population, animal protein intake (measured in Kg per person-year), arable land (measured in hectares), and GDP (measured in PPP of 2011 constant USD). The GDP data was obtained from the World Bank website as the FAOSTAT dataset had several unreported countries.

Finally, the trade matrix that contain the origin and destination of imports and exports was also included in the database. The trade matrix has two versions, the quantities reported by the exporter and the quantities reported by the importer. Since the possibility that both figures do not match exists, both versions of the trade matrix were considered in order to reconcile the discrepancies. This matrix was obtained from the trade domain of the FAOSTAT website and display the quantities of commodities traded between exporters and importers explicitly.

3.2 Methodology

The GVC-CA method introduced in the literature review section was followed as the analytical framework to address the research objective of this thesis. The proposed method builds on the benefits and advantages of both traditional GVC and cluster analysis. In order to choose the research methodology, two aspects were considered. First, that evidence to support the existence of a soybean-meat GVC existed; and second that the ultimate objective of this thesis was to specify the structure of the soybean-meat GVC and ultimately to explain the soybean-meat linkage.

The GVC-CA permitted to identify the fragmentation of production, and the international linkages that are fundamental steps in order to specify the structure of a GVC. In the other hand, GVC-CA allowed to analyze several quantitative data that permitted to strengthen the conclusions from traditional GVC and to account for the heterogeneity that result when a sample of 178 countries is studied.

Although a GVC analysis does not constitute a hypothesis testing methodology, it facilitates the analysis of specific questions that cannot be addressed by other methods (Roldán-Pérez et al., 2009). In this sense, the methodology has to be seen as an inductive research method rather than a deductive one.

The proposed GVC-CA method was implemented at the country level rather than at the firm level as the traditional GVC analysis methodology is usually applied. Working at the country level has the benefit that quantitative country-aggregated data can be included in the analysis, and a much larger sample can be considered. This improvement strengthens the analysis as the conclusions can be supported by quantitative results obtained from a larger sample. However, working at the country level does not permit to conduct an analysis of the governance structures of the value chain neither to study the upgrading process, which are relevant aspects of the traditional GVC methodology. Nevertheless, in achieving the objectives sought by this thesis the governance and upgrading analyzes were not essential. Consequently, an analysis of the governance and upgrading process of the soybean-meat value chain was considered out of the scope of this thesis.

The proposed GVC-CA methodology started with an examination of the other three dimensions of the traditional GVC analysis. These three dimensions were the analysis of the input-output structure, the geographical consideration and the analysis of the institutional context. The purpose of the first part of the methodology was to describe the structure of the soybean-meat GVC, as well as to provide an analysis of the state of this value chain.

The production, demand/supply and trade figures were employed to map the global input-output structure, to study the trends in supply and demand, and to analyze the international trade configuration. The trade matrix was used to examine the international linkages between countries. The trade matrix was analyzed using network graphs. In this purpose, NodeXL and Google Fusion Tables were used as tools for the work. Lastly, in order to analyze the institutional context, a case study approach was followed. The analysis was based on an exhaustive review of the literature accompanied by concrete examples to illustrate the constructs developed. The results of the GVC analysis were synthesized in charts and tables that were discussed in the results section.

The GVC analysis also included an analysis of the concentration of the value chain. To measure the concentration of the value chain, a Herfindahl-Hirschman Index (HHI) was developed. An HHI index was computed for each stage of the value chain, and for both, the supply, and the demand side. Herfindahl indexes were also calculated for exports and imports figures to quantify the concentration of international trade. The HHI is a widely accepted measure of concentration, and very often is used to assess market concentration. For instance, the antitrust division of the U.S Department of Justice uses the HHI to evaluate the competitiveness effects of potential mergers. (US Department of Justice, Website). The HHI was computed as follows.

$$HHI_j = \sum_{i}^{n} (S_{ij})^2 * 10.000$$

Where, S_{ij} expresses the share of country i over the world's total for the variable being analyzed. The HHI ranges from $1/n$ * 10.000 to 10.000. An HHI of 10.000 represents a total concentration in one single subject. The U.S Department of Justice considers markets with values above 2.500 to be concentrated and from 1.500 to 2.500 to be moderately concentrated (US Department of Justice, Website).

The research process continued with a cluster analysis in order to develop the taxonomy proposed in the specific objectives. The CA method followed was the one detailed in the literature review chapter. The data was analyzed using the Stata statistical package. To find the best clustering results, the same clustering process was performed several times altering the selected clustering variables, the proximity index, and the linkage method. The various clustering results obtained were compared, and the one that offered the most meaningful and robust results was selected.

Specific objective number five was to segment meat demand based on the preference (taste) for either poultry or hog meat. Based on the construct proposed by Goldsmith (2015b), "taste" was considered as a preference towards certain kind of meat. In turn, "taste" may be regarded as the technology exhibited by a demand function for meat. It was observed through the GVC part of the GVC-CA method that some countries exhibited a preference towards poultry instead of pork and vice-versa. Without regard to the variability in local prices, and for the same income level, the variation in poultry and pork demand from country to other was attributed to differences in "taste" (or technology).

The objective then was to classify markets based on the "taste" (or technology) exhibited. The demand for meat was regarded as a function of income. Three prospective clustering variables were selected. These were the per-capita demand for pork, the per-capita demand for poultry (expressed as the 2010/2011 average in kg-year), and the GDP per-capita (expressed as the 2010/2011 average in 2011 constant USD in PPP). Three transformations of each variable were also considered. These were the natural logarithm of the original variables, the standardized (zero mean and unit standard deviation) equivalents of the original variables, and the standardized equivalents of the natural logarithm of the original variables. The clustering routine that returned the best results was the k-means with a correlation distance as proximity index between poultry and pork per-capita demand. The variable GDP per-capita was dropped from the analysis.

Specific objective number six was to segment meat supply based on the sourcing profile of each country. Considering that local demand can be met either by domestic production or imports, then the objective was to classify countries into self-sufficient and importers. Also, the trend of this profile was a classification goal. Two variables were created to describe the sourcing profile and its trend. For both, poultry meat and pork demand, the ratio of the local production to the local demand was computed. This ratio was calculated for the average figures of years 2010/2011 and 1997/1998. The second variable created was the trend of the production to demand ratio. It was computed as the CAGR of the ratios from 1997/1998 to 2010/2011. The standardized equivalents of the original variables were also considered.

A non-hierarchical method was chosen since it was considered more efficient due to the possibility of cluster re-assignation during the clustering process. Since a non-hierarchical method uses a centroid clustering approach, it is susceptible to outliers. In consequence, two countries were not included in the analysis. These countries were Turkey and Denmark in the case of pork meat. Countries with neither demand nor production of pork were also excluded. This initial screening yielded a sample of 155 countries for the pork analysis and 172 countries for the poultry analysis.

The K-means algorithm with the Euclidian distance was chosen to classify the production to demand ratio. The variables employed were the standardized equivalent of the production to demand ratio in years 2010/2011 and 1997/1998. The variable representing the trend of the ratio was dropped since it was redundant. By considering just the ratios in years 2011/2011, and 1997/1998, the trend was implicitly included. Since the K-means algorithm requires a pre-defined number of clusters, the routine was run for three to eight clusters and the Calinsky-Harabasz index was computed for each number of clusters to evaluate the optimal result.

Specific objective number seven was to develop a taxonomy of the archetypes at each stage of the value chain of meat. To meet this objective, the 2010/2011 supply/demand, trade and processing figures at each stage (soybean, SBM, meat) at the country level were considered. The figures were transformed into their logarithmic equivalents to smoothen the differences in scale between variables. Considering that local supply is a linear combination of production, imports, and exports; local demand was not considered in the analysis. The latter three variables besides to soybean processing were included in the clustering analysis.

The two-phase cluster analysis method was employed in this case. First, the centroid non-hierarchical method was used. In order to find the optimal number of clusters, the Calinsky-Harabasz, and the Duda-Hart index were computed. Then, the K-means algorithm with a correlation distance as proximity index was employed. The correlation distance enabled the algorithm to cluster correlated variables.

Specific objective number eight was to develop a taxonomy of the archetypal value adding strategies followed by countries. A value adding strategy in the context of the soybean-meat GVC can be understood as the advancement towards a fully integrated value chain at the country level. This means that a country is able to integrate local production of raw materials (soybean), intermediates (SBM) and final products (meat), and, therefore, captures the most value from the value chain.

Cluster analysis was used to construct clusters of countries with similar value adding strategies. The clustering variables considered were the logarithmic form of local demand and local production of meat and SBM. In the case of soybean was used the local processing and the local production figures. The two phases clustering process was used. First, the centroid linkage non-hierarchical algorithm was run to find the optimal number of cluster. Then, the K-mean algorithm was run to better cluster the sample. The correlation distance was used as the proximity index in order to cluster variables based on their correlation.

Finally, regression analysis was employed to study the determinants of each stage of the soybean-meat value chain. The purpose was to understand how each stage was linked to the other stages of the value chain.

The specific objective number nine was "to measure the determinants of the production of meat". Specifically, the goal was to determine if SBM production and soybean production were necessary conditions (or determinants) for the production of meat at the country level. Since local meat production could either met the local demand or exported to supply international markets, local supply/demand of meat and meat exports at the country level were variables also considered in the analysis. A log-log model was employed to estimate the elasticity of meat production given the production of SBM and soybean as well as the local meat supply/demand and meat exports. The following functional form was fitted using ordinary least squares (OLS).

$$Log\ (MeatProd_i\,) = \beta_0 + \beta_1\ \log(MeatDemand_i) +\ \beta_2\ \log(MeatExp_i) + \\ \beta_3 \log(SoybeanProd_i) +\ \beta_5 \log(SBMProd_i) +\ \mu_i$$

4. RESULTS

4.1 Review of the state of the soybean-meat value chain

In concordance with specific objective number 4, a review of the state of the meat-soybean value chain is presented below.

Poultry meat and pork are the most popular sources of animal protein. Poultry demand was found in all of the 178 countries studied, while pork demand was found in 152 countries. Nevertheless, the world's demand for pork continues to be higher than that for poultry. In the years 2010/2011, the global per-capita consumption of pork was 16.8 kg while poultry meat was 14.5 Kg. Despite these absolute values, poultry meat demand showed a more dynamic behavior, averaging a 3.7% annual growth (CAGR), in contrast to a 2.1% for pork. This more dynamic behavior translates into a yearly trend of 3 million and 2 million additional tons respectively. The stronger growth of poultry demand contributed to shortening the gap between poultry and pork demand. In the years 1997/1998, pork demand represented 57% of the total combined demand for poultry and pork. In years 2010/2011, this figure was 51% as depicted in figure 4.

A similar pattern was observed for SBM demand and soybean demand with an average growth of 4% from 1997 to 2011. This growth represented a yearly trend of 5.8 million tons, and 8.4 million additional tons of SBM and soybean respectively. The higher growth rate (compared to meat) in SBM and soybean demand, could be explained by the SBM transition process described by Xing and Goldsmith (2013). Although meat production can be a good proxy for SBM demand when considering developing regions with lower industrial development, the transition from non-commercial to commercial feed adds significantly to the demand for SBM else equal. Tuan et al. (2004) describe SBM usage as a proxy for the transition from non-commercial operations to large-scale commercial operations. The higher rate of growth of SBM demand compared to meat production growth can be understood as a continuous transition to commercial production of poultry and pork during the years from 1997 to 2011.

The international trade of soybean and SBM was found to be significantly larger than the international trade of meat. Figure 5 depicts the ratio of the world's imports over the world's total demand for meat, SBM and soybean. In years 2010/2011 this ratio for SBM and soybean was more than twice that for meat measured in terms of the volume traded. Nevertheless, the trend in international trade at all stages (meat, SBM, soybean) was positive for the years 1997/1998 to 2010/2011.

Poultry

When disaggregated at the country level a diverse outlook is found. The per-capita-year demand of poultry is highly heterogeneous among countries; it ranged from 84 kg to less than 1 kg. The median per-capita consumption was found at 17 Kg. A list of the top 25 per-capita-year consumers is shown in Table 2. During the period analyzed, the per-capita demand grew at an average of 2.5% a year. A list of the top 25 rates of growth of per-capita-year poultry demand for countries with more than 100.000 tons/year demand is shown in Table 3. Myanmar and Vietnam were the fastest per-capita growing countries among the top 25 markets for poultry in 2010/2010. In contrast, negative per-capita demand growth was found in 22 countries. The most significant were The UAE, France, Thailand, Italy, Ireland and the Netherlands. Except for Thailand, all these countries have a high per-capita income. These countries also display a weak per-capita demand of poultry compared to the demand for pork.

The biggest single markets for poultry meat in years 2010/2011 were China (Mainland), The USA, Brazil, and Mexico. Together accounted for 44% of world's demand. A complete list of the top 25 markets for poultry is shown in Table 4. The same four countries were the top 4 poultry producers in years 2010/2011. Together accounted for 48% of world's production. The list of the top 25 poultry producers is shown in Table 5. Among the top producers, only France decreased production between 1997 and 2011. In contrast, Russia and Myanmar had the highest growing rates; 10.7% and 15.8% respectively.

The analysis of the incremental demand showed that China was the main source of additional demand during the period from 1997 to 2011. China accounted for 17% of the total incremental demand, followed by the USA, Brazil, and Russia. These four countries accounted for 40% of the total additional demand during this period. The details are shown in figure 6. Similarly, these four countries were the top 4 sources of incremental production. Together accounted for 50% of the additional production between 1997 and 2011. Brazil and China excelled as the largest sources of additional production, each of them contributing with 17% of the total additional production. The details are shown in figure 7.

The USA and Brazil experienced a production rate faster than the local demand; this suggests the generation of surpluses for exports. In contrast, the local Chinese demand and production grew in tandem. In the case of Russia, despite local production exceeded domestic demand, the country remained as a net importer of poultry as of the years 2010/2011. However, the higher production rate contributed to reducing the dependence on imported poultry at an average rate of 6% a year from 1997 to 2011.

Among the top 10 importers of poultry, Russia was the only one that reduced its demand for imports. In the other hand, Viet Nam saw a tremendous growth of imports of 60% a year. Together, the top 10 importers accounted for 55% of the world's total imports. The list is shown in Table 6. Among these importers, only the Netherlands and China (mainland) were not net importers as of the years 2010/2011. The list of the top 10 net importers is shown in Table 7, with Japan as the single largest net importer of poultry meat.

The top 2 exporters of poultry were The U.S and Brazil, together accounted for 50% of the world's exports in years 2010/2011. The top 10 exporters together accounted for 83% of the world's exports. Brazil, Poland, and Germany experienced remarkable rates of growth of exports. On the other hand, among the top exporters, only France reduced its exports from 1997 to 2011. Among the top 10 exporters are the Netherlands, Hong Kong, and Germany. Despite, their large exporting figures, these countries also showed large imports. For instance, The Netherland's net exports (after deducting imports), were less than 50% of the total exports. This difference can be explained by large imports intended for further re-export. The case of Hong Kong and Germany exemplify this situation clearly. Despite being large exporters of poultry, the countries were net importers as of the years 2010/2011. Even more, during the same years, Hong Kong was the largest single importer of poultry in the world. The details of the top 10 exporters and the top 10 net exporters of poultry are shown in Tables 8 and 9.

Pork

The per-capita demand for pork grew at an average of 1.6% a year from 1997 to 2011 reaching an average demand of 16.8 Kg and a world median of just 8.5 Kg in years 2010/2011. The highest per-capita demand were above 50 Kg and the lowest below 3 Kg. Additionally, several countries showed no demand for pork. The details are shown in Tables 10 and 11. These tables summarize the top 25 per-capita consumers, and the top 25 fastest growing markets in terms of per-capita demand (only markets with a minimum demand of 50.000 Tons/year as of 2010/2011 were considered). The top fastest growing markets were mostly developing countries with low per-capita consumption. The majority of the countries that showed a decreased in per-capita demand were either, countries with very low or very high per-capita demand.

In Table 12 is shown the details of the top 25 markets for pork, as of years 2010/2011. The largest single market as of years 2010/2011 was China (Mainland), accounting for around 46% of the world's demand. This market is the largest by far as the second biggest market, the USA, accounts only for 8% of global demand. The relevance of China in the pork market is increasing as the country's demand grew at a rate of 3% a year from 1997/1998 through 2010/2011. The dynamic of Viet Nam also has to be noted. The country experienced a growing rate of 7% from 1997 to 2011 and became the fifth largest market for pork. China also was found to be the biggest producer of pork, accounting for 45% of the world's production. China had a rate of growth of production similar to the growth in demand. The details are shown in Table 13.

The analysis of the incremental demand and production showed that China is by far the largest contributor to both, additional demand, and additional production. China itself contributed to 60% of the additional demand and production from 1997 to 2011. The details are shown in Figures 8 and 9.

The analysis of the international trade of pork showed that the top 4 exporters accounted roughly for 50% of world's exports in years 2010/2011. Three of the top 4exporters –Germany, The U.S, and Spain- exhibited growth rates of exports greater than 10% a year. The growth of the Brazilian exports was also remarkable with 15% a year, only behind Germany with a 16% a year. Although a modest increase in exports, Denmark continued to be the largest net exporter of pork as of years 2010/2011. The details are shown in Tables 14 and 15. Similar to poultry imports, several pork-exporters countries were at the same time significant pork-importers. This is the case of Germany, which is the largest exporter, and at the same time the single largest importer of pork. Although Germany is a net exporter, imports as of years 2010/2011, represented around 50% of the country's total exports. The details of pork imports are shown in Tables 16 and 17.

SBM

Developing countries, with expanding meat production, were also found to have fast growing demand for SBM. China showed one the highest growth rates and became the largest market for SBM as of years 2010/2011. Along with China; Russia, Iran and Argentina showed the highest rates of growth in SBM demand. In the other hand, developed countries with large meat markets showed small growing rates in SBM demand. This is the case of the U.S, Canada and Germany. In these cases, the growth in the demand for SBM was significantly slower than the rate of growth in meat production. China, the U.S., and Brazil, the largest meat producers, accounted for around 50% of the world's total SBM demand. These three countries besides Argentina were also responsible for 75% of the world's SBM production as of the years 2010/2011.

Around 40% of the world's incremental demand for SBM came from China (Mainland). At the same time, China generated 44% of the world's additional production of SBM. This is, the same outlook observed in the case of meat production. China appears to be meeting all of its additional demand for poultry, pork and SBM. In the other hand, Argentina became the single largest supplier of SBM to the international market. Despite accounting for just 3% of the world's incremental demand of SBM, the country generated 24% of the world's incremental production from 1997 to 2011. In 2010/2011, it concentrated 40% of the world's SBM exports. In this period, three countries –China, Brazil and Argentina- generated 84% of the world's incremental production of SBM. As of the year 2010/2011, these three countries and the U.S accounted for 77% of the total global SBM production. The details are shown in Tables 18-23, Figure 10, and Figure11.

Soybean

Soybean's demand and production grew at a rate of 4% a year from 1997 to 2011. For several countries, the demand for soybean followed the demand for SBM. This is the case of the USA and Brazil. In contrast, other countries showed a disequilibrium between the local demand for SBM and soybean production. This is the case of countries such as Argentina, Paraguay and Uruguay, for which the growth in soybean's production exceeded the growth in the domestic demand in SBM. In contrast, countries such as China, Viet Nam, the Netherlands and Germany, experienced larger increases in the demand for SBM compared to the increase in soybean production.

In years 2010/2011, the top 4 markets for soybean accounted together 75% of the world's demand for soybean. Among the top 25 markets for soybean, Ukraine, Russia, Egypt, Turkey and China experienced very high rates of growth in the demand for soybean. However, 80% of the incremental demand for soybean between 1997 and 2011 came from three countries, China, Argentina and Brazil. The incremental production of soybean was concentrated in three countries that accounted for 83% of the total incremental production from 1997 to 2011. These countries were the same that concentrated the incremental demand for soybean, except that China was replaced by the USA in this group. The details of the top 25 markets for soybean and the top 25 producers of soybean are shown in Tables 24 and 25. The details of the incremental demand and production (supply) are shown in Figures 12 and 13.

The international trade of soybean appeared to be linked to the country's production figures. Except by China, all the top producers were also top exporters. The activity of trading countries seemed to be less relevant than in the stages of SBM and meat. Only the Netherlands was identified as a trading country. Despite not producing soybean as of year 2010/2011, the Netherlands was the seventh largest exporter of soybean. Slovenia was also identified as a trading country with a tremendous growth in import/exports of more than 100% a year. Nevertheless, the country still accounts for less than 1% of the world's exports. The role of China within world's imports has no parallel. As of the years 2010/2011, China accounted for nearly 60% of the world's soybean imports compared to Mexico that was the second largest importer accounting for just 4% of the world's imports. The details are shown in Tables 26-29.

4.2 The input-output structure and its geographical consideration

A detailed trade matrix was used to analyze the international input-output structure. The first finding was a very intricate network of international trade at the three stages. Due to this, the top exporters in each stage were selected for the analysis. In all cases, the top exporters accounted for 80% to 98% of the total world's trade. The data used, in this case, were the 2010/2011 import figures reported by each country that originated in one of the selected exporting countries. Furthermore, only importers that represented at least 2% of the total exports of the selected exporters were considered for the analysis.

Soybean

In Figure 14 is shown the network of soybean trade. In the figure, the size of the nodes represents the trading volume in a worldwide context. The blue nodes represent countries that only reported exports. The arrow represents the direction exports to imports (net trade in case of a bilateral trade). Finally, the thickness of the arrow represents the volume traded. As it was noted before, in years 2010/2011 China accounted for almost 60% of the world's soybean imports. This is evident in Figure 14, in which additionally can be seen that the US, Brazil, and Argentina were the main suppliers of China besides to Uruguay and Canada that also were suppliers of China. Argentina, Brazil, and the US were the largest exporters of soybean. It seems to exist a symbiotic relationship between large producers/exporters and the single largest importer. In the other hand, medium exporters, such a Canada, Paraguay, and Ukraine exhibit more diversified exports in terms of the number of countries supplied.

These medium exporters seem to be supplying several countries that are not attended by the three large exporters. The graph also reveals the importance of the Netherlands as a regional trading hub connecting European countries with Brazil and the U.S. Slovenia, although trading smaller quantities is found as another regional trading hub.

Figure 15 shows the importance of each market for the exporters analyzed. The thicker the line, the more dependent is the exporter on the linked market. Additionally to the already observed dependence of the big exporters in China, was found that Argentina and Uruguay supply almost their entire soybean exports to China. In the case of the Netherlands, its principal market for the re-export of soybean is Germany. In the case of Slovenia is clear that the country re-exports almost its entire imported volumes (from Paraguay) to Italy.

A question can be posed then. Is the increasing concentration in soybean trade creating market niches for medium exporters such as Canada, Ukraine, and Paraguay? When figure 16 is analyzed, is clear that many small to medium markets are relying heavily on imports from these countries. Figure 16 shows the percentage of the local demand that is supplied by imports. The thicker the line, the more dependent is the importing country on its linked supplier to meet local demand. The bigger nodes that represent Canada, Paraguay, and Ukraine, show that several countries depend on these suppliers to source their domestic market.

SBM

The first point to be noted is the irrelevance of China in the international trade of SBM. In this case, no dominant importer is observed. The single largest importer is the Netherlands, but in Figure 18 can be seen that again the Netherlands is performing as a regional trading hub. It concentrates exports from Argentina and Brazil, to re-export to other European markets. Argentina can be clearly identified as the dominant exporter with a diversified portfolio of destinations for its exports. This configuration can be better seen in Figure 17, in which the importance of each market is shown for each exporter. The thicker the line, the more dependent is the exporter on the linked market. In this Figure can be seen that Brazil is highly dependent on exports to the Netherlands, Germany and Poland. This Figure also reveals a more complex trading pattern within Europe. Besides the Netherlands, Germany, Belgium and Slovenia are regional trading hubs. For instance, Belgium is importing and producing SBM in order to supply France mainly. Germany concentrates exports to Czech Republic and Poland. Slovenia in turn is almost exclusively supplying Hungary and Italy.

Another interesting feature of the international trade of SBM is the segregation of trade. Figure 19 reveals that several countries rely on single sources to supply the local market. This Figure shows the percentage of the local demand that is supplied by imports from the linked supplier. Smaller countries in Europe engage in unilateral trade with Germany and the Netherlands in order to source the local market. In turn, the Netherlands and Germany are sourcing SBM exclusively from Argentina and Brazil (both directly and through the Netherlands in the case of Germany). The US shows very little trade with Europe and concentrates its exports to Asia, Central and North America. In the case of Canada, although it is a significant exporter of soybean (including exports to the US), it imports a large share of its local supply of SBM from the US.

In Figure 19 can also be identified additional patterns or regional trade. India and Bolivia, which are medium exporters of SBM, direct their exports exclusively to regional partners. In the case of India, Asian countries; and in the case of Bolivia Andean countries. In Figure 18 can be seen, that India depends heavily on imports from Japan, and Bolivia is highly dependent on imports from Venezuela and Peru.

Poultry

Traditionally the U.S has been the largest exporter of poultry meat. As shown in figure 20, as of years 2010/2011 the U.S. accounted for about 25% of the world's exports. The pattern displayed by the node representing the U.S. can be interpreted as consolidated export destinations where the U.S sees no significant competition from other suppliers. Was found that the U.S single largest destination for exports is Mexico, followed by Canada. During the period analyzed Brazil was the largest emergent exporter of poultry meat, its position as a contender for U.S exports can be evidenced in Figure 20. As of years 2010/2011, Brazil had a market share of exports similar to that of the US. Brazil appears to be entering several markets to compete with established suppliers. The most significant of these markets are Japan, Hong Kong, Russia and Saudi Arabia.

Besides Brazil, the Netherlands, Belgium, and especially Germany and Poland have been increasing their exports. Each of these countries seems to be consolidating other European markets and little competence between these exporters is seen. A big exception is the UK, which has a diversified portfolio of suppliers.

The Netherlands, Germany, and Hong Kong are operating as regional trading hubs for poultry meat. Hong Kong operates like a distributor of poultry from Brazil and the U.S to other Asian markets. Most of its exports are routed to Viet Nam, Macao, Mainland China, and the Philippines. The Netherlands is a net exporter of poultry meat. However, it is a significant importer of poultry from Brazil, as well from Europeans partners such as Germany, France and Belgium. On the other hand, Germany appears to be a trading hub similar to Hong Kong. Despite being a larger exporter, was found to be a net importer of poultry meat.

As a general observation, the trade network of poultry meat within European countries is more intricate than the pattern observed in the case of soybean and SBM. For these stages, very often the relationship found was unilateral, meaning that just a few countries concentrated exports of SBM and soybeans. In the case of poultry trade, several bilateral relationships can be seen in several countries.

Pork

Pork trade is mainly concentrated within European countries. Seven out the ten world's largest exporters are European countries. As figure 22 shows, a very intricate network of trade can be observed. Within Europe, Germany is the central hub, both for production and trade. This complex network might be the result of the several further processed pork made products in which pork can be traded. This is, pork-derived products such as the different kinds of delicatessen. Nonetheless, deeper analysis of the specific pork made products traded is necessary to validate. Dissimilar to its European peers, Denmark is found closer to Asian and North American markets with which has a significant trade. This can be seen in Figure 22.

Value chain concentration

Although in previous paragraphs the analysis of the concentration was already considered using concentration ratios, a more standardized approach was also used to make a comparison of the concentration across stages and time. In this purpose, Herfindahl-Hirschman Indexes were calculated. In Figure 23 is shown the HHI computed for poultry, pork, SBM and soybeans as of years 2010/2011.

The first consideration is the increasing concentration backwards in the value chain. This is; poultry showed less concentration than SBM, and SBM in turn showed less concentration than soybeans. A second consideration is the recurrent higher concentration of production compared to that of the demand (except in the case of pork). The difference is evident in the initial stages of the value chain. For instance, the difference between HH indexes for soybeans production and supply are more than a 1000 units. This is evidence of the dependence of several countries on imports to supply the local market.

The higher concentration of production is due to the existence of a few large producing players in each stage of the value chain. In the other hand, the smaller concentration of the demand suggests that this is dispersed more evenly within countries. In consequence, a higher concentration of exports is seen since only some countries are capable to export. For instance, in the case of SBM the difference in concentration between imports and exports is more than 2000 units. This difference is the result of the very high exports of Argentina, which accounts for around 40% of the world's exports of SBM.

The same analysis can be extended to poultry as the U.S and Brazil generate 50% of the world's exports. The case of soybeans is different, both imports and exports are highly concentrated. The market shares of the U.S and Brazil, which combined concentrate 75% of the total exports, can explain the concentration of exports. On the other hand, the fact that China accounts for nearly 60% of the total imports of soybeans leads to balance the relationship imports/exports in terms of market concentration.

The pork market behaves differently due to the role of China. As noted before, China itself accounts for around 50% of the world's pork market and is self-sufficient. Consequently, a concentrated but balanced market is seen.

The analysis of the evolution of the market concentration showed no significant changes except for the steep growth in the concentration of soybeans imports because of rapidly increasing Chinese imports. Before 2002, the soybeans imports concentration was very similar to the one of the other stages of the value chain –SBM and meat-. With a CAGR of 14% on HHI, from 2002 to 2011 soybeans imports move from a low concentration index of 1000 to a very concentrated index of 3000 in a period of just ten years. All of the poultry HH indexes decreased slightly during the period analyzed, suggesting a worldwide expansion of poultry. Although the international trade of pork decreased its HHI index, due to the increasing role of Chinese demand/production, the HHI for supply and demand increased at a rate of 1.6% (CAGR). The historical evolution of the HHI of pork, poultry, SBM and soybeans are shown in Figures 24-27.

4.3 The local and institutional context

The study of governance refers to the study of the power relationships between actors of the value chain. This study typically takes place at the firm level, at which the relationships are possible to be isolated and studied. Since the present analysis took place at the country level, an analysis of the governance structure was not included. At the country level, the institutional context bears more relevance to identify constraints, and incentives that might explain the value chain structure and the linkages identified. The objective was then to analyze how the local and the institutional context create barriers and incentives within the soybean-meat GVC. In this purpose, three dimensions were examined. These dimensions were the tariff-related policy, technical and sanitary barriers, and natural resources constraints.

The first dimension to consider is the availability of natural resources at the country level. Specifically, in terms of agricultural production, land and water are the crucial resources. Avoiding the discussion of the sufficiency of the world's stocks of land and water to meet the future demand for agricultural production, when the analysis is disaggregated at the country level, the outlook reveals severe distortions. The distribution of land and water does not match the pattern of demand around the world. Certain countries have surpluses of natural resources relative to their local demand while several other countries have deficits.

The uneven distribution of natural resources can become in a natural barrier in the soybean-meat global value chain. Some countries see a comparative advantage compared to others in terms of the production of a land-intensive crop such as soybean. This situation can be clearly exemplified with the analysis of the trade between Argentina, Brazil, and China.

Following the soybean trade liberalization by China in the mid-1990s, the country perceived an astonishing increase in soybean demand. For the period analyzed from 1997 to 2011, China accounted for 47% of the additional demand for soybean yet did not increase its production. In contrast, Argentina and Brazil –countries with natural resources surpluses- accounted for nearly 70% of the additional soybean production during this period. China is forecasted to increase its dependence on imported soybean considering its strong land constraints as well as the local policy of privileging self-sufficiency in crops such as corn.

Trade policy (tariffs and non-tariff measures) aims to manage the transaction costs in international trade in order to protect local industries. Despite the trend toward the liberalization of the world's economy, agricultural trade is still limited heavily by trade policy compared to other sectors (Anderson and Martin, 2005). Within the soybean-meat value chain, SBM and meat trade is more restricted than soybean trade that is relatively unrestricted (USDA, 2012). The trading policy set the limits for local production either positively or negatively since it dictates the possibility that local production go beyond the domestic market.

The case of the US-China poultry dispute can be used to exemplify the impact of trade policy on the soybean-meat value chain. Goldsmith (2015a) documents the China-USA poultry dispute. Before 2009, Chinese poultry imports from the U.S were growing at a rate of 50% a year until 2010 when U.S exports to China fell 80% compared to the previous year. The plunge was the result of new import tariffs on poultry from the U.S as a reaction to higher tariffs on imported tires to the U.S from China. China supported its allegations on dumping practices by the U.S poultry exporters and set anti-dumping duties to poultry imports from the U.S ranging from 50.3% to 105.4% (Goldsmith, 2015a). Despite the U.S request to the world trade organization (WTO) to arbitrate in the dispute, as of 2014, the import tariffs are still effective.

The development of free trade areas, such as the NAFTA and the European economic zone, lift the barriers to the free flow of goods. Free trading areas can be seen as an equivalent of the expansion of the local market. The case of the Polish poultry industry can be used as an example. From 1997 to 2011, Poland increased its poultry meat exports at a CAGR of 17%. Despite its domestic demand expanded at a rate of 3.5%, its local production of poultry expanded at a rate of nearly the double. When the international linkages were analyzed was found that most of Poland's trading partners are European countries.

In years 2010/2011 Argentina concentrated 13% of the world's soybean exports while in turn, during the same years, it concentrated 40% of the world's SBM exports. To understand this difference and what encouraged the upgrading from soybean production to SBM production, is necessary to consider the internal policy of taxes on exports. In 2006, Argentina implemented the so-called differential export tax (DET) system. This policy established differentiated tax rates for soybean and SBM, of 23.5% and 19.3% respectively. The DET system artificially encourages the exports of SBM instead of raw soybean (Deese and Reeder, 2007). Such policies are effective when the product taxed is inelastic or the producer controls a large portion of the output, which is the case of Argentina.

Due to the biological nature of agricultural production, another type of trade barriers arises in the context of the soybean-meat value chain. International trade legislation allows countries to impose protocols to protect humans, animals and plants from diseases and contaminants. Under this legislation, the supplier is compelled to meet certain standards imposed by the buyer. Analyzing such policies can contribute to understanding the relationship identified between The E.U and Argentina.

GMO production is a controversial topic that is differently approached by different countries. The U.S and The E.U have antagonistic attitudes towards GMO. The U.S propitiates a friendly environment for GMO production different from that of the EU, where public opinion against GMO technology hinders acceptance of GMO crops and their derivatives such as SBM. For instance, in the U.S a complete GMO approval process can take up to 15 months while in the E.U the same process can take up to 2.5 years. The discrepancy can lead to "asynchronous authorizations" on new GMO traits (European Commission DG Agriculture report, 2007)

Argentina, as a large producer of soybean and a consumer of GMO technology, is affected by the "asynchronous authorizations" phenomenon. Due to its relatively small domestic market for soybean products, Argentina relays heavily on exports. Since its principal partner for

SBM trade is the E.U, and to preserve its SBM exports, Argentina is compelled to meet the EU's zero-tolerance policy for non-approved GMOs. It has been documented that Argentina has delayed and constrained the approval of new GMOs attuned with the E.U legislation (European Commission DG Agriculture report, 2007). Compared to the U.S, Argentina is more prone to constraint its local legislation regarding GMO technology in order to meet the European import protocols. The absence of significant competition from the U.S in the European market has permitted Argentina to increase its share on Europe's SBM imports.

Similar sanitary measures can be observed in other stages of the value chain. For instance, China has used this kind of barriers to limit the trade of poultry. China has prevented poultry imports arguing the presence of the aviary flu strains in birds' flocks of potential exporters. Despite such measures are part of standard sanitary protocols, on several occasions the decision has generated controversy since the measures have been regarded as the result of commercial motivations.

An additional technical barrier in the context of meat production is worth to be considered. Meat is one of the most perishable commodities. Distribution of meat requires refrigeration that increases the logistic cost compared to other not or less perishable products. This result in a concentration of production in proximity to demand (Narrod et al., 2008). Figures 28 and 29; show the map of human and poultry concentration in Asia and Africa. A correlation between both can be observed. The concentration of meat production in proximity to demand and the trading policies barriers may contribute to explain the weaker international trade of meat compared to other stages of the soybean-meat value chain.

The GVC analysis of the soybean-meat value chain permitted to disclosure an international network at the three stages of the value chain. At all stages of the value chain several countries were found to be linked to others in order to source and/or supply raw materials (soybean), intermediates (SBM) and/or finished products (meat). Despite this generalization, the international linkages at the bottom of the value chain –SBM and soybean- were observed to be significantly stronger than at the top (meat) of the value chain. It seems that meat production is tightly correlated to local demand; in consequence, the size of the local market may be a strong constraint on meat production at the country level.

Moreover, through GVC analysis could be evidenced the heterogeneity existing among countries inserted into the soybean-meat GVC. It was discussed how the local and institutional context may influence the form in which a country is inserted into the soybean-meat GVC.

A diagram of the soybean-meat GVC is presented in Figure 30. The diagram was constructed based on the international input-output structure. These input-output structures are summarized below.

At the raw materials stage (soybeans):

- Produce to Supply (other uses) (P2S)
- Produce to process (P2P)
- Produce to export (P2E)
- Import to process (I2P)
- Import to export (I2E)

At the intermediates stages (SBM):

- Produce to feed (P2F)
- Produce to export (P2E)
- Import to feed (I2F)

- Import to export (I2E)

At the product stage (meat):

- Produce to food (P2Fd)
- Produce to export (P2E)
- Import to Food (I2Fd)
- Import to export (I2E)

4.4 Meat market segmentation

The classification based on taste revealed two distinct clusters. The cluster of countries with a preference towards pork and the cluster with a preference towards poultry. The first cluster can be labeled as poultry meat eaters. This group accounted for 68% of all observations. This is, 113 countries out of 165 studied. For this group, the demand for poultry meat was statistically higher than that for pork. The average per-capita demand for poultry of this group was found to be 24 kg per year and its per-capita demand for pork just 7 Kg per year. The details are shown in Table 30.

The second cluster can be labeled as the pork eaters. The demand for pork was statistically higher than that for poultry. The average per-capita demand for pork was found to be 30 Kg per year, in contrast to the demand for poultry that was only 16 Kg per year. The details are shown in Table 31.

The differences in taste lead to think the existence of different meat-income elasticities depending on the technology (taste) exhibited by the demand function of each cluster. Being able to estimate a more accurate income elasticity can benefit the forecasting of future poultry and pork demand.

Specific objective number 6 was to classify poultry and pork markets based on their sourcing profile. Local demand can only be met by either local production or imports. In this sense, two sourcing profiles or sourcing archetypes can exist, self-sufficient markets and importer markets. The ratio described in the methods section can be understood in the following way. A value of one and higher represents a self-sufficient market (including exporter countries in the case of ratio > 1). A value lower than 1 represents an importer market, in which the local production cannot meet the local demand.

In practice, several countries showed a mixture of these two archetypes. An importer market would be self-sufficient up to some degree. Also, the production in some self-sufficient markets could meet more than once its local demand, which is translated into surpluses for exports. Furthermore, the trend of each market could be reinforcing its archetype or reverting it. If these considerations are made, a more detailed classification could be done.

The clustering process yielded six optimal clusters in the case of poultry markets and 7 in the case of pork markets. The details of the clusters can be seen in Tables 32, 33 and 34.

Two clusters (1 and 6) out of the six poultry clusters identified can be classified as self-sufficient markets. The other four (2, 3, 4 and 5) can be classified as importer markets. Nevertheless, self-sufficient markets combined, represented around 55% of the total countries studied. Each of the clusters is discussed below.

Cluster 1 grouped the countries with a demand-production ratio significantly higher than one. These are countries with a significant production surplus with respect to its local demand. Through the period analyzed this group of countries saw, on average, an increase in their surpluses at a rate of 1.6% a year. Cluster 6 grouped half of the total sample and corresponded to the archetype of self-sufficient countries for which the demand-production ratio is close to one.

This group of countries on average maintained their self-sufficiency archetype. Through the period analyzed the average trend of the ratio was close to zero. Some particular cases are worth to note since they differ slightly from the cluster's archetype observed. The ratio of the U.S could resemble more the average ratio of cluster 1. Nevertheless, it was included in cluster 6 as its profile did not change over time, and the surplus is slower than that exhibited by cluster 1. Ukraine, although its ratio as of years 2010/2011 fits the archetype of self-sufficiency adequately, showed a significant growth through the time similar to the one shown by cluster 5. Germany showed an analogous behavior, moving from being a major importer to becoming in an almost self-sufficient country. The case of France is the opposite; it moves from being an exporter similar to countries in cluster 1 to become an almost archetypal self-sufficient country in years 2010/2011.

Cluster 5 grouped countries that showed a substantial growth in their demand-production ratio but still were poultry importers. This group of countries was unique among the sample in the sense that the countries undoubtedly reverted the archetype of an importing market. The most relevant case is Russia, which reduced its dependence on imports to a level similar to the one showed by several countries in cluster 6.

Clusters 2 and 3 grouped the importer markets that reinforced their archetype strongly. As of years 2010/2011, this group of countries was almost entirely dependent on imports and saw a strong trend towards the archetype of an importer-market.

Lastly, cluster 4 grouped several countries that although classified as importer markets, also exhibit a significant local production. On average, this group of countries increased their dependence on imports.

The clustering of the pork market yielded similar results to those of poultry. Similar behaviors could be observed in the pork market. The largest single cluster is the archetypal self-sufficient profile that accounted for 37% of the countries studied (cluster 3). This cluster of countries showed a demand-production ratio clustered around one. Same as in the case of poultry, this group on average, maintained their self-sufficiency status through the period analyzed. Different from the case of the poultry market, no cluster of countries was found to be evolving towards self-sufficiency. The only cluster of countries that was found to be reverting its archetype was cluster 5. Nevertheless, this small group of small markets is heavily dependent on pork imports. The reversing trend just slightly reduced their dependence on imports.

A subgroup of countries in cluster 3 is worth to mention. These are Brazil, Chile, Germany, and the U.S. These countries slightly differ from the pure self-sufficiency archetype and show ratio values higher than one, suggesting significant surpluses for exports. The most relevant case is Germany, which moved from being an importer to becoming in a self-sufficient market with surpluses for exports.

Cluster 1 corresponds to the self-sufficient markets with significant surpluses for exports. On average this cluster reinforced its archetype through the period analyzed. Spain and Canada increased their pork production surpluses strongly.

Clusters 4 and 6, grouped countries that significantly reinforced their importer market archetype. Cluster 6 exhibited a strong evolution towards dependency on imports; on average, this cluster of countries exhibited a decrease in their demand-production ratio of 7% a year. Cluster 4 represented countries that lost their self-sufficiency status or increased their dependence on imports. Cluster 4 exhibited a significant decrease in its average demand-production ratio. Although in years 1997/1998 the cluster's average ratio was below one, several countries were found to be self-sufficient. For instance Korea and the Czech Republic. During the period analyzed their large pork markets became significantly dependent on imports.

4.5 Taxonomy of the archetypal roles of actors at each stage of the value chain of meat

Specific objective number seven was to provide a taxonomy of the roles of countries at each stage of the value chain. The goal was to classify countries depending on their roles as importers, exporters or traders at each stage of the value chain. The GVC analysis permitted to map the value chain from soybean to meat production. At each stage, some patterns of behavior were observed among actors of the value chain. This observation led to think of some archetypal behaviors at each stage of the value chain. Being able to find statistically similar behaviors among the countries studied can support the existence of the archetypal behaviors proposed.

Soybean archetypes

The optimal number of clusters was found to be seven. The details are shown in Tables 35 and 36. These results were obtained when Uruguay was excluded from the analysis. Uruguay was considered to have a unique behavior. As the correlation distance was used as proximity index, then a unique correlation pattern could be regarded as an outlier. For this reason, it was studied independently. Considering the figures of year 2010/2011, Uruguay can represent the archetype “Produce to Export”. It exported its entire production of soybean. In fact, this archetype was not empirically discovered from the sample analyzed. Can be concluded that Uruguay is the only country that exhibited this archetypal behavior within the sample of countries studied.

Clusters 2 and 5 were associated with the archetype Import to Process (I2P). These two clusters summed roughly 50% of the total sample analyzed. The countries in these clusters showed a high correlation between soybean imports and soybean processing. Soybean processing is necessary to produce SBM locally. These countries, therefore, exhibited a behavior of importing raw materials to produce intermediates locally. The difference between clusters 2 and 5 is that countries in cluster 2 additionally to be soybean importers were also significant soybean producers. Cluster 2 showed then a combination of archetypes I2P and Produce to process (P2P). China can be taken as the most relevant example in cluster 2 and Germany in Cluster 5.

Clusters 3 and 6 are similar in that both clusters grouped countries that did not process soybean although some local demand for soybean existed. This demand is the product of other uses of soybean different from SBM production. For instance, soybean as food or feed for livestock. Cluster 3 grouped countries than mostly did not produce soybean. Consequently, the demand had to be met with imports. This behavior corresponds to the archetype of Import to Supply (I2S) that can be represented by Peru. In the other hand, cluster 6 grouped countries with a similar demand pattern, but were able to meet the demand mainly with local production. This behavior corresponds to the archetype of Produce to Supply (P2S). In the case of P2S, 50% of the countries displaying this behavior were African nations. Malawi or Rwanda can represent the archetype.

Cluster 1 grouped 16 countries that showed no soybean activity, this is neither demand nor production of soybean. Cluster 4 grouped five countries that exhibited a high correlation between imports and exports of soybean. This correlation is associated with the archetype of import to export (I2E). Slovenia can represent the archetype. It imported a significant quantity of soybean at the same time it exported a similar amount. It showed no production and an insignificant local demand. The GVC analysis revealed that Slovenia is a waypoint of South American soybean into Italy. The Netherlands and Belgium, classified in cluster 7 also showed a significant I2E behavior.

Lastly, cluster 7 grouped the countries that showed a high correlation between soybean production and soybean processing. This correlation corresponds to the archetype of Produce to Process (P2P). This archetype describes a tight relationship between soybean production and SBM production. A few considerations have to be mention. All the big soybean producers clustered in this group exhibited significant soybean exports as well. This behavior, produce to export, corresponds with the archetype P2E represented by Uruguay. In fact, Canada, Paraguay and Ukraine (grouped in cluster 7) exhibited a behavior closer to P2E rather than P2P.

A subgroup of six countries in cluster 7 (Burkina Faso, Cambodia, Kazakhstan, Nigeria, Romania, and Zambia) seem to exhibit a combination of archetypes P2P and P2S. Different from countries in cluster 6, these countries exhibited significant processing figures. Even though, a big portion of the production of soybean was not processed but it was used in other activities such as food for humans, feed for animals, etc. This behavior is similar to an archetypal P2S. Finally, Haiti was considered a classification error since it clearly belongs to cluster.

SBM archetypes

The analysis of the SBM data set yielded an optimal result of four clusters. This result gave the most meaningful interpretation as well. The first point to be noted is that most countries exhibited a mixed behavior or a combination of archetypes. Nonetheless, it was possible to find significant leading or principal archetypes within clusters. In the case of soybean, several unique archetypal behaviors were identified. In contrast, the mixed results of the SBM analysis are considered the result of the absence of the natural resources constraints found in soybean production. Without these constraints, more countries are capable to participate in the production of SBM. The details of the clustering results are shown in Tables 37 and 38.

Cluster 1 is comprised of the countries that showed no SBM activity; this is neither demand nor production. Members, of this cluster, are either island nations or small markets in low-income countries. No SBM activity can lead to think of the existence of markets entirely dependent on imports, and in other cases, markets where industrial livestock production is close to zero.

Cluster 2 is comprised of the countries that despite being large SBM importers also showed significant local production. The leading archetype associated with this cluster was the import to feed (I2F). The secondary archetype associated was the produce to feed (P2F) archetype. This cluster showed no significant exports of SBM, except for the case of Germany.

Cluster 3 was the largest group; it clustered 38% of the observations. This cluster corresponded to medium size SBM markets that are dependent on imports. No significant SBM production was found among these countries. If the Netherlands and Slovenia were excluded from this cluster, it would be possible to associate cluster 3 exclusively with the archetype Import to Feed (I2F). The Netherlands showed a profile similar to Germany. It showed a P2F archetype (as cluster 1) but also I2E and I2F. The archetype import to export (I2E) was not found within the data, but Slovenia could represent this archetype as it showed no production nor significant demand but large imports and exports of SBM.

Finally, cluster 4 grouped countries that showed no significant imports of SBM. This characteristic led to associate it to the archetype Produce to feed (P2F) as leading archetype. Nonetheless, an important subgroup of countries in cluster 4 were also exporters of SBM. This feature is associated with the archetype Produce to Export (P2E). P2F can be represented by China while P2E can be represented by Argentina, Bolivia or Paraguay.

Meat archetypes

Similar to the SBM results, meat clusters yielded mixed archetypes. The optimal solution was 5 clusters. The vast majority of the countries analyzed were found to be producing meat up to some degree. Only a small cluster of seven countries (cluster 4) did not show the archetype Produce to Food (P2Fd).

Cluster 4 gathered countries that relied heavily on meat imports to meet local demand. The main archetype is then associated with the Import to food (I2Fd) archetype. Within this cluster, Hong Kong, behave slightly different since besides I2Fd, it also showed the Import to Export (I2E) archetype. The GVC analysis showed that indeed Hong Kong was performing as a meat trading hub to re-supply poultry from the US into other Asian markets.

Cluster 2 gathered 28% of the observations or 49 countries that clearly showed the archetype P2Fd. These countries appear to have independent meat markets since the local production meets local demand. Italy, a member of this cluster, is considered to fit better the characteristics of cluster 5. Despite, having large local production, significant imports were found.

Clusters 5 and 3 can be considered as opposite clusters. Cluster's 5 leading archetype was P2Fd and its secondary archetype I2Fd. In the other hand, cluster's 3 leading archetype was I2Fd, and its secondary was P2Fd. Both clusters combined, represented nearly 50% of the observations. In both cases, although local production existed, was not enough to meet domestic demand entirely. Nonetheless, countries in cluster 3, on average were dependent on meat imports.

The last cluster to discuss is cluster 1. The common characteristic was the existence of the archetype P2Fd, which is the leading archetype of this cluster. All of the cluster's members were able to meet local demand with local production. In this sense, a few countries were found to be closer to cluster 2, in which P2Fd is the leading and unique archetype. The most relevant case is India, which appears to be an independent market like those in cluster 2.

The secondary archetype of cluster 1 was the Produce to Export archetype (P2E). Several countries were found to be able not only to meet local demand but also to have significant surpluses to export. Moreover, in three countries, Belgium, the Netherlands and Denmark, was found that production appears to be motivated by exports. The leading archetype of these three countries could be Produce to export (P2E) which was not discovered independently. These three countries besides to Canada and Germany also showed a behavior proper of the Import to Export Archetype (I2E). The I2E archetype was only observed in Hong Kong, but Germany appears to display this archetype as well.

4.6 Taxonomy of the archetypal value adding strategies followed by actors of the value chain

When single stages of the value chain are considered is not possible to assess comprehensibly the form in which each country is producing meat. An inter-stage analysis was then necessary to identify the meat producing behavior exhibited by countries. This behavior can be understood as the capability of locally capture more value from the value chain. The analysis permitted to identify four value-adding strategies. These were namely: End Product Consumers, Intermediates Value Adders, Raw Materials Value Adders and Vertical Integrators.

The End Product Consumers refer to countries that mainly supply their local meat demand with imported meat. Intermediate Value Adders means countries that are importers of SBM in order to produce meat locally. Raw Materials Value Adders refers to countries that are importers of soybean to produce SBM locally and ultimately meat. The Vertical Integrators are countries that are capable to produce soybean, SBM, and meat locally.

The value adding analysis yielded nine distinct clusters of countries. The archetypes described earlier were found alone or in combination with others in each cluster. An additional behavior arose from the analysis. This behavior was named the disconnected value chain. This group of countries showed an apparent disconnected value chain in which production of meat and production of soybean were not linked. The details of the clusters are shown in Tables 41 and 42. Each of the clusters is described in the next paragraphs.

Due to the complexity of the analysis, the data set had to be analyzed by parts. The first cluster analysis was carried out on the 174 countries studied. It yielded the clusters 6, 7 and 8 shown in Table 41. An additional cluster containing 74 countries was generated from this initial analysis, but it had to be re-analyzed due to lack of meaningful results. The second cluster analysis yielded the clusters 1 to 5 in Table 41. Cluster 9 is comprised of a single country that had to be treated as an outlier. Despite having obtained results that were more meaningful after the second cluster analysis, some reclassifications had to be done in clusters 1, 2, 4 and 5.

The first cluster routine classified the data based on the variable “soybean processing”. Clusters 6, 7 and 8 are comprised of countries that share the absence of soybean processing, and consequently no local production of SBM.

Cluster 7 could be associated with the archetype “Final product consumer”. Neither significant SBM production nor SBM demand was observed. In general, these countries showed high dependency on imported meat. Some of these countries exhibited local production, but it was considered as “backyard” production and not the result of commercial meat operations. These countries are small island nations and low-income countries with small markets. Island nations with higher income were found to be more dependent on imports than low-income countries such as Ghana, which showed significant local production (although believed to be from non-commercial operations).

Cluster 6, similar to cluster 5, showed a significant dependence on meat imports. Nonetheless, significant local meat production was found as well. The local production is dependent on SBM imports since not significant local SBM production was found. This cluster was associated with the archetype Intermediates Value Adder and Final Product Consumer as the secondary archetype.

Cluster 8 is similar to cluster 6 in which both exhibited imports of meat but also significant local production with imported SBM. Cluster 8 is unique in the sense that at the same that a demand for SBM and local production of soybean existed, no soybean processing was evidenced. Consequently, no SBM production was evidenced either. A disconnection between soybean production and meat production seems to exist. The most relevant cases are Malawi, Bangladesh, and Rwanda. This cluster was associated with the archetypes Disconnected Value Chain and Intermediate Value Adders.

Clusters 1 to 5 did show significant soybean processing. Nonetheless, heterogeneous archetypes were associated with each cluster. Cluster 5 grouped seven countries for which the value chain from soybean to meat could be traced. In general, these countries were at least self-sufficient in raw materials, intermediates and finished products. The exception is Russia, which although exhibiting the same behavior, also showed significant imports of meat and SBM. The case of Uganda is relevant. Uganda is the only African country that showed this behavior. This cluster was associated with the archetype Vertical Integrator.

Cluster 1 was associated with the archetype Raw Materials Value Adders. This group of countries are self-sufficient in final product and intermediates but are clearly dependent on imported raw materials. The most representative country can be Taiwan.

Clusters 2 and 3 were associated with the archetype Intermediates Value Adders. These countries were mainly heavy importers of SBM to produce meat locally. Nevertheless, some countries were found to be, additionally, big meat importers such as the case of Japan. Cluster 2 was also associated with the archetype Raw Materials Value Adder. Cluster 2 appears to be a midpoint between clusters 3 and cluster 1. Exhibiting some transition in the value adding process. An interesting case in cluster 3 is South Africa. Despite being a significant producer of soybean, South Africa is an archetypal Intermediates Value Adder. Local soybean production seems to be constrained. Only a fraction of the production is processed into SBM. The remaining production is locally supplied for other uses.

Finally, cluster 4 was associated with the archetype Disconnected Value Chain. This group was almost self-sufficient in meat and SBM but exhibited a significant surplus on soybean. Another characteristic was the weak demand for SBM. This cluster is similar to cluster 8 but is different in that the countries in cluster 4 were capable of locally supplying the SBM demand. Even though, both clusters exhibited low soybean processing figures compared to their soybean production. In this sense, soybean production may be outpacing commercial meat production. At this early stage, soybean production may be encouraged by local demand for other uses different from SBM production. As meat production begins the shift to commercial production, soybean starts to be processed into SBM. Cluster 8 could precede cluster 4 in the upgrading process.

Cluster 9 represented Canada, which was not possible to be classified. It exhibited a unique profile. Canada is both, an Intermediates Value Adder, and a Raw Materials Value Adder.

Moreover, it showed significant soybean and meat surpluses. The GVC analysis showed that Canada is engaged in trade with the US. It was a major importer of SBM from the US yet a significant exporter of pork to the U.S.

Based on the value-adding strategies and the clusters identified, five value-adding archetypes can be proposed, namely: soybean value adders, SBM value adders, meat importers, disconnected value chain, and clustered value chain. Except by the archetypal meat importers, all countries clustered around soybean and SBM production. It was common to these countries that meat production was consistently significant in all cases. These archetypes can be interpreted then as the different possible value-adding strategies to transform soybean and/or SBM into meat.

4.7 Regression analysis

In order to continue the analysis, the determinants of meat production at the country level were estimated employing the following model.

$$Log\ (MeatProd_i) \ = \ \beta_0 + \beta_1\ \log(MeatDemand_i) + \ \beta_2\ \log(MeatExp_i) + \beta_3 \log(SoybeanProd_i) + \ \beta_5 \log(SBMProd_i) + \ \mu_i$$

This model measures the elasticity of meat production at the country level given the size of the domestic meat market (meat supply/demand), the exports of meat, the availability of SBM (SBMProduction), and soybean (SoybeanProduction) at the country level. The results are presented in Table 43.

The model employed explained 86% of the variation in meat production at the country level. The first result to be noted is that variables “Meat exports”, “soybean production” and

SBM production showed no statistical significance. This means that meat production at the country level is not determined by the exports of meat, either by the availability of soybean or SBM. In contrast, the variable Meat supply/demand was found to be statistically significant even at a 1% significance level. Since the model employed was the log-log, coefficients can be interpreted as elasticities. In this sense, the results show that for a 1% increase in the demand for meat, production of meat at the country level increased by around 1.15%. This result supports the fact that the domestic meat market size is a limitation of meat production.

The results for the variable "SBM production" were surprising since SBM is a component of meat. This finding can be better understood if the SBM production industrial nature is considered. SBM production is an industrial activity subjected to economic variables similar to those that affect other industrial sectors. Goldsmith et al. (2004), evidenced how soybean processing (SBM production) is limited by capital investments, which in turn depends on economies of scale, full capacity utilization and readily access to soybeans.

Despite being a component of meat, SBM production may be influenced stronger by the local investment environment. This idea concord with the findings of multiple value-adding strategies. As evidenced, SBM production is not necessary to produce meat locally considering the existence of a GVC that gives access to imports of SBM.

5. CONCLUSION

This thesis work studied the soybean-meat global value chain in order to provide a specification of the structure of this value chain and ultimately being able to explain the linkage between soybean and meat production. Additionally, this work proposed the GVC-CA method as a more robust alternative research methodology in the field of global value chain analysis.

The research work began with a GVC analysis of the soybean-meat value chain at the country level. The work focused on the analysis of the input-output relationships, their geographical consideration, and the local and institutional context at the country level. The goal was to describe the structure and dynamics of the soybean-meat value chain.

The research continued with a cluster analysis that permitted to address the heterogeneity evidenced through global value chain analysis. The main objective was to develop a taxonomy of the different value-adding strategies followed by countries participating in the soybean-meat value chain. Additionally, a segmentation of the meat market was part of the work.

Lastly, a regression analysis was employed to evaluate the linkages among stages of the soybean-meat GVC. The objective was to understand the determinants of meat, SBM, and soybean at the country level.

The two distinguishing characteristics of a GVC are global fragmentation of production and significant international trade. These characteristics allow carrying out all the necessary activities to bring a finished product to market at the best location. In this context, countries and firms can specialize in the value-adding activities at which they are most competitive. It also enables actors of the value chain to learn and “upgrade” to activities with more value added and take advantage of a global market.

The analysis conducted permitted to identify fragmentation of production and significant international trade within the soybean-meat value chain. It was evidenced how countries engage in trade in order to supply or source raw materials (soybean), intermediates (SBM) and meat (finished product).

Nevertheless, it was identified that the size of the domestic meat market is a significant constraint within the soybean-meat GVC. The regression results showed that meat production at the country level is determined mainly by the size of the domestic meat market. This means that meat production tends tend to develop in the proximity of the demand for meat. Bearing this in mind, can be concluded that the sole availability of soybean at the country level is not a sufficient, nor a necessary condition to produce meat.

Based on the archetypes studied, can be concluded that there is no a single value-adding strategy, but rather multiple value-adding strategies to produce meat. Within the soybean-meat GVC, countries can source SBM and/or soybean from other countries in order to produce meat for their local market. Having access to the GVC of SBM and soybean is then, the necessary condition to produce meat locally.

Porter (1998) introduced the concept of the so-called clustered value chain. Oppose to the arms-length value chain, a clustered value chain is a geographic concentration of firms of a particular field. While an arm-length organization permits to mitigate input-cost disadvantages, a clustered organization favors productivity, competitiveness and has a greater economic positive impact.

The results in this work evidenced how some countries can cluster the three stages of the soybean-meat value chain while others display the arms-length organization proper of a GVC.

If the major limitation to developing a soybean-meat cluster is the local meat market size, this creates opportunities for countries that already developed a local meat market big enough to sustain a cluster. This situation is especially significant for countries in Africa and Latin America, which have growing local meat markets besides to vast natural resources stocks. The challenge for these countries is then to create the right economic conditions to propitiate a “clusterization” of the soybean-meat value within the country.

The main question that remains is if the domestic meat market will continue to be a big constraint to the local production of meat. It was observed that some countries were showing growing imports of meat while others, growing exports. More research is needed to understand the social, environmental and economic constraints for the domestic production of meat.

The existence of constraints to locally produce meat can create opportunities for a greater international trade of meat in the near future. In this context, countries with clustered soybean-meat value chains will perceive a competitive advantage to conquer these new opportunities.

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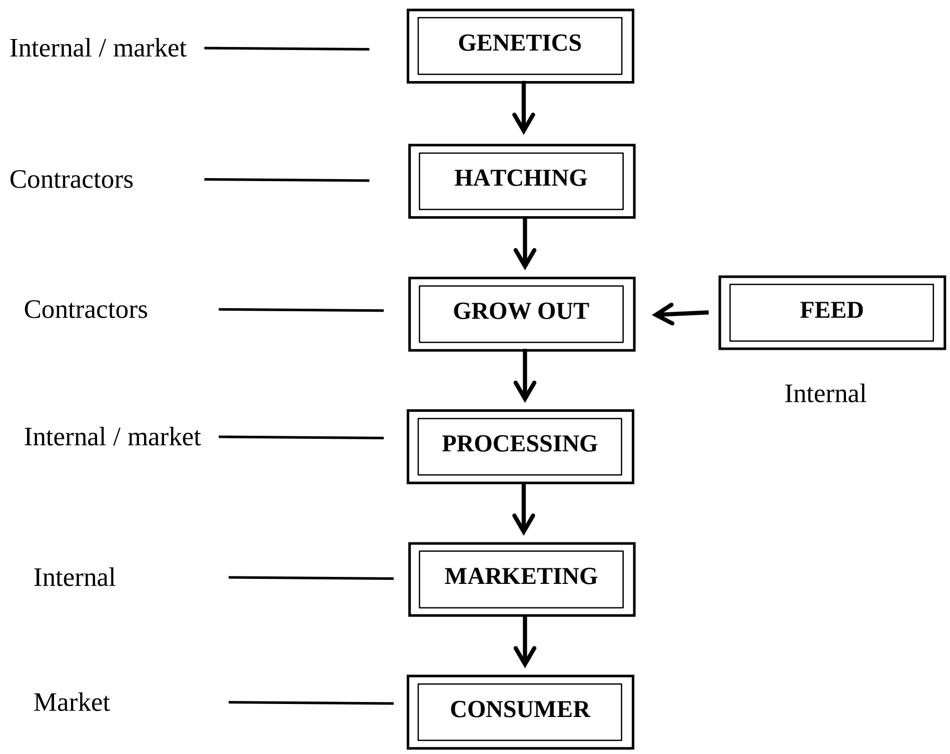
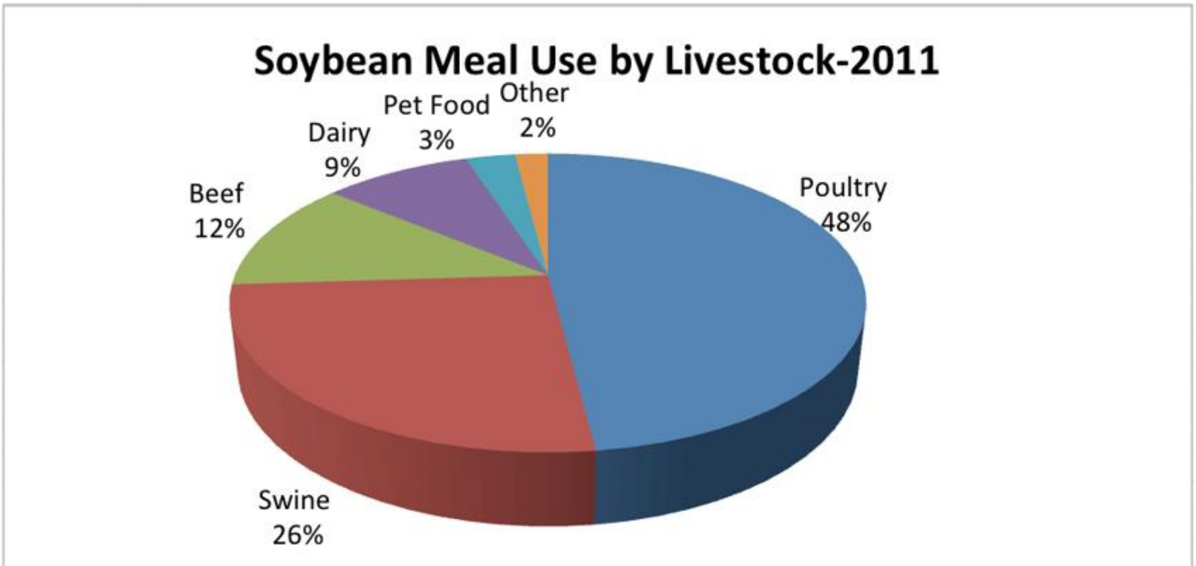
FIGURES

Figure 1 Integrated poultry meat operation



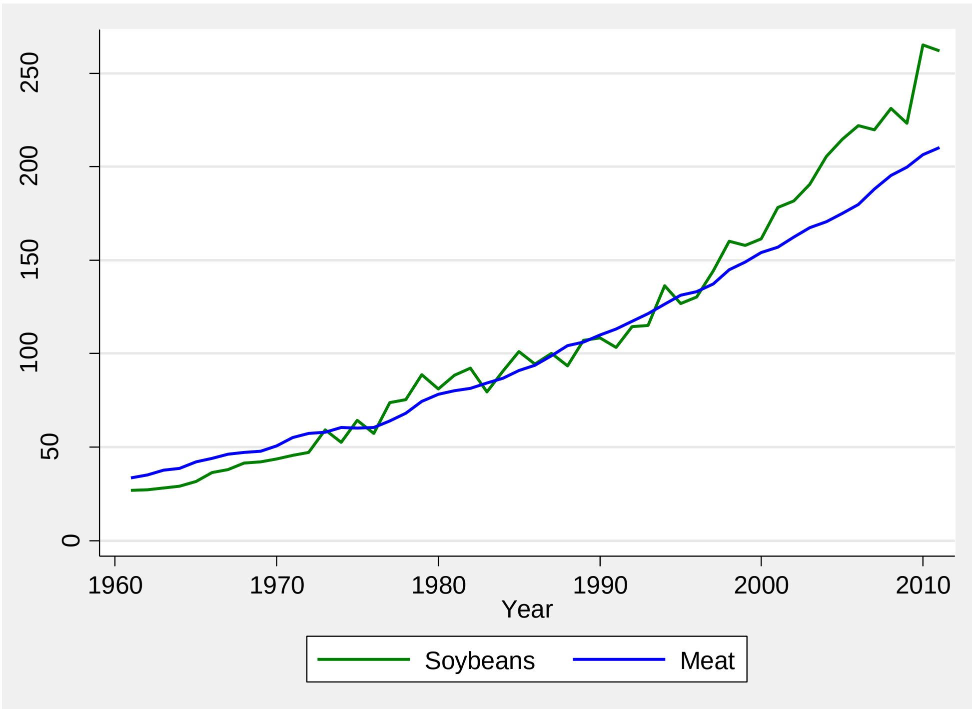
Source: Adapted from Narrod et al, 2008; Miles et al, 2012.

Figure 2 SBM use by livestock species in the U.S in 2011.



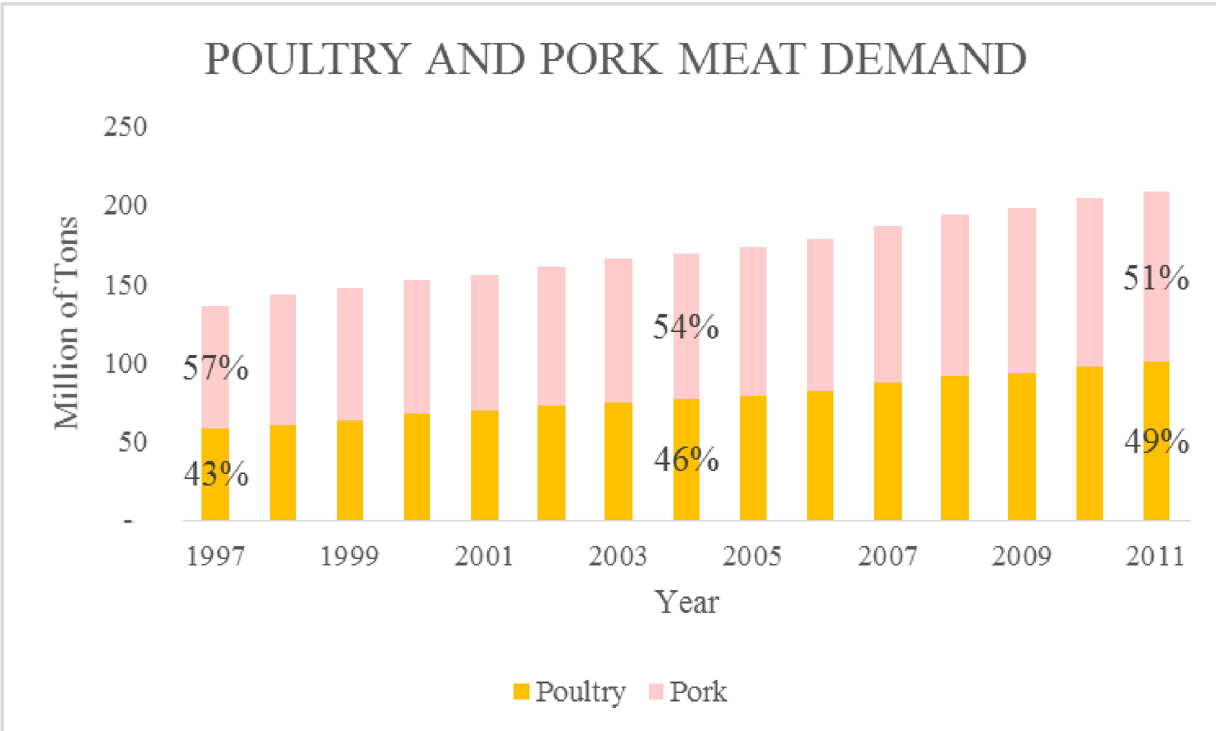
Rererence: www.soystats.com/2012

Figure 3 World soybean and meat (swine and poultry) production 1961 - 2011



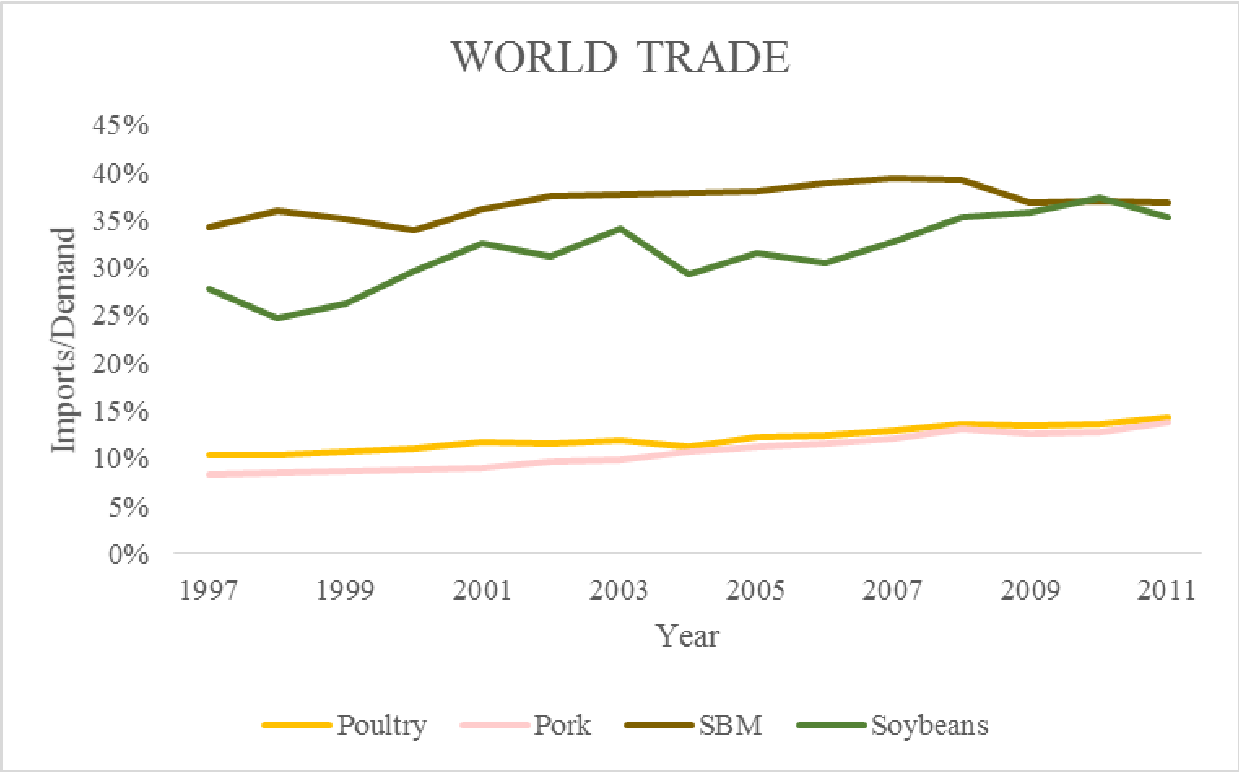
Source: Author’s calculation based on FAO data

Figure 4 World demand for poultry and pork. 1997-2011



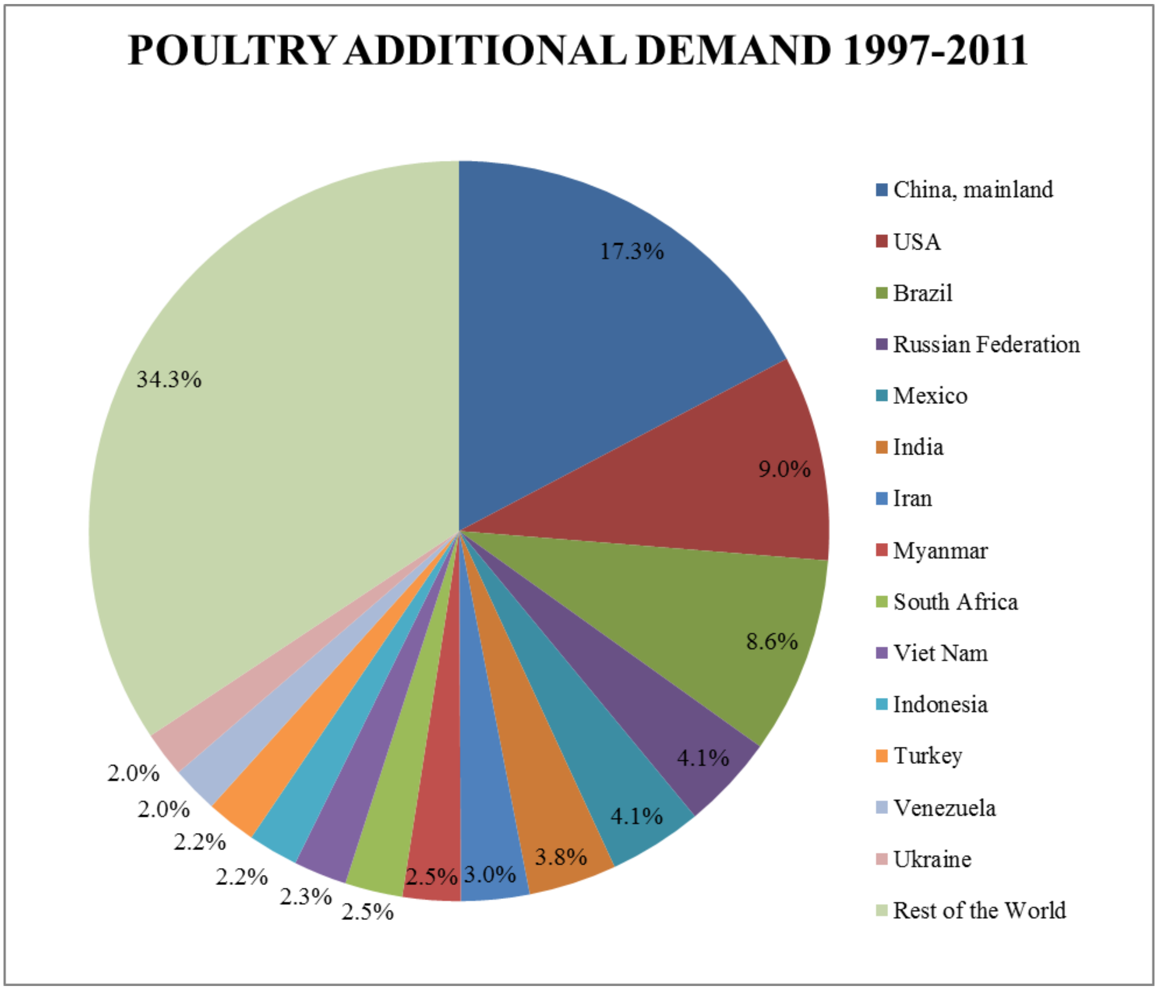
Source: Author's calculation based on FAO data

Figure 5 World trade shown as the percentage of imports over total demand 1997-2011



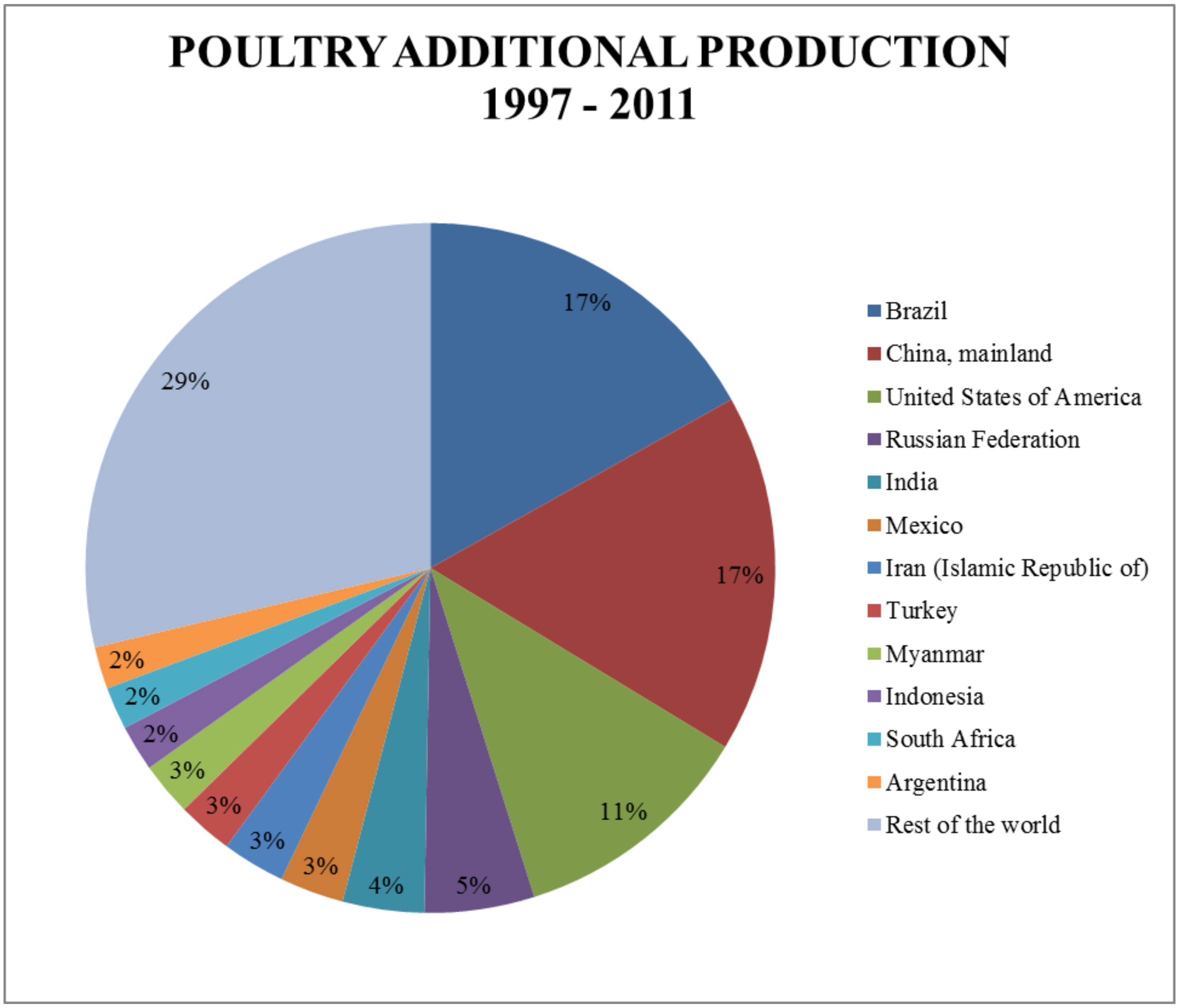
Source: Author's calculation based on FAO data

Figure 6 Poultry additional demand 1997-2011



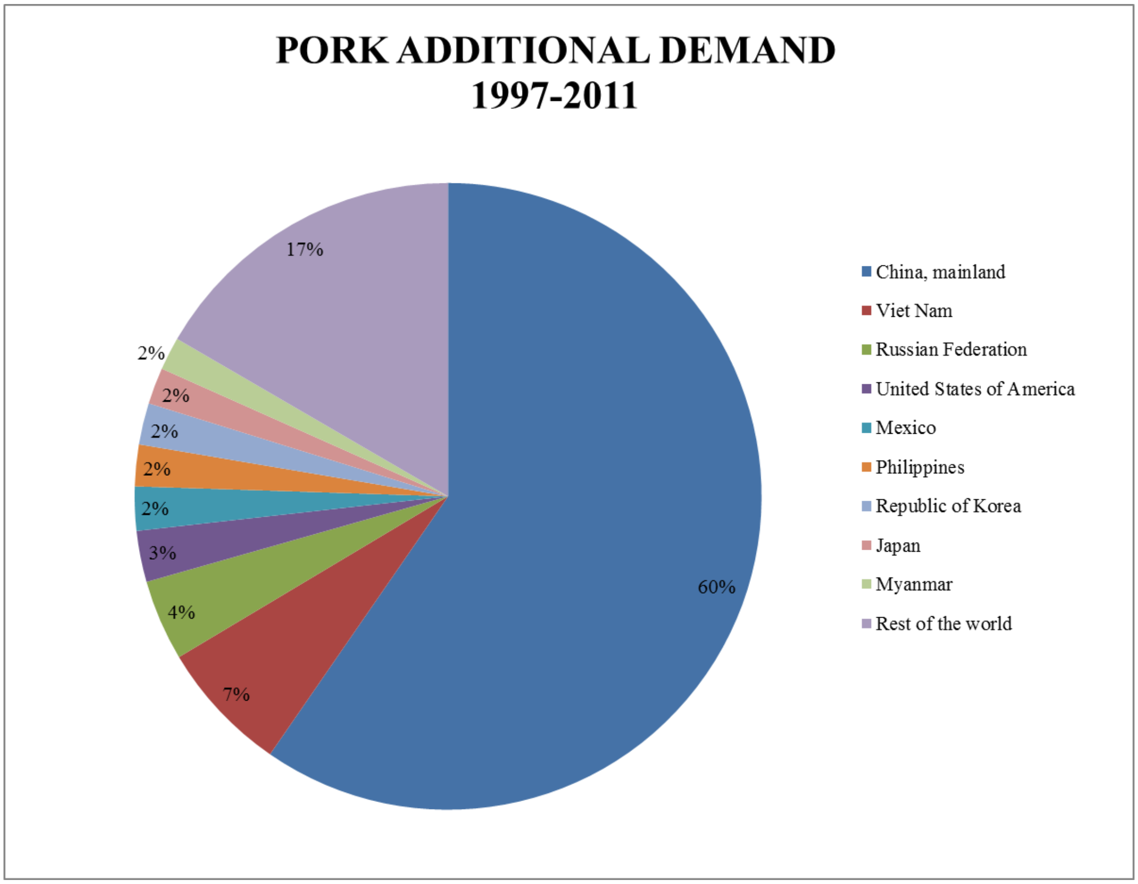
Source: Author's calculation based on FAO data

Figure 7 Poultry additional production 1997-2011



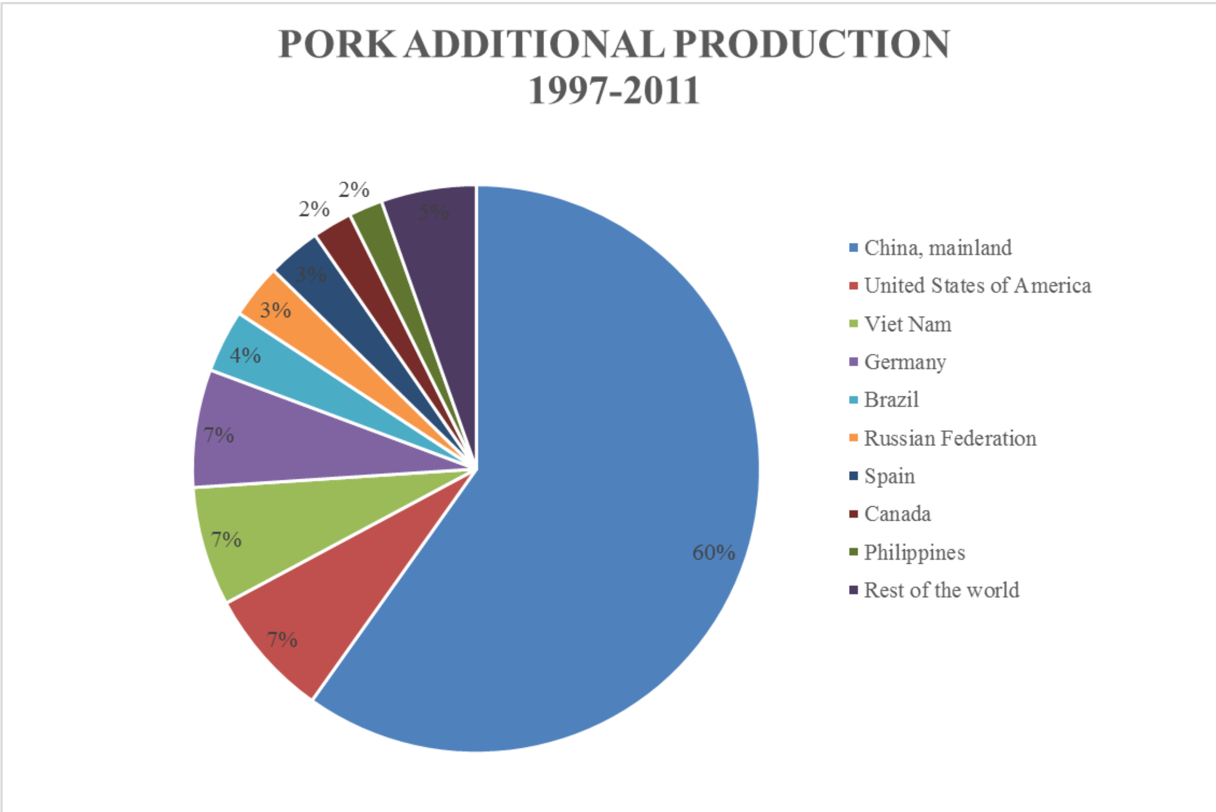
Source: Author's calculation based on FAO data

Figure 8 Pork additional demand 1997-2011



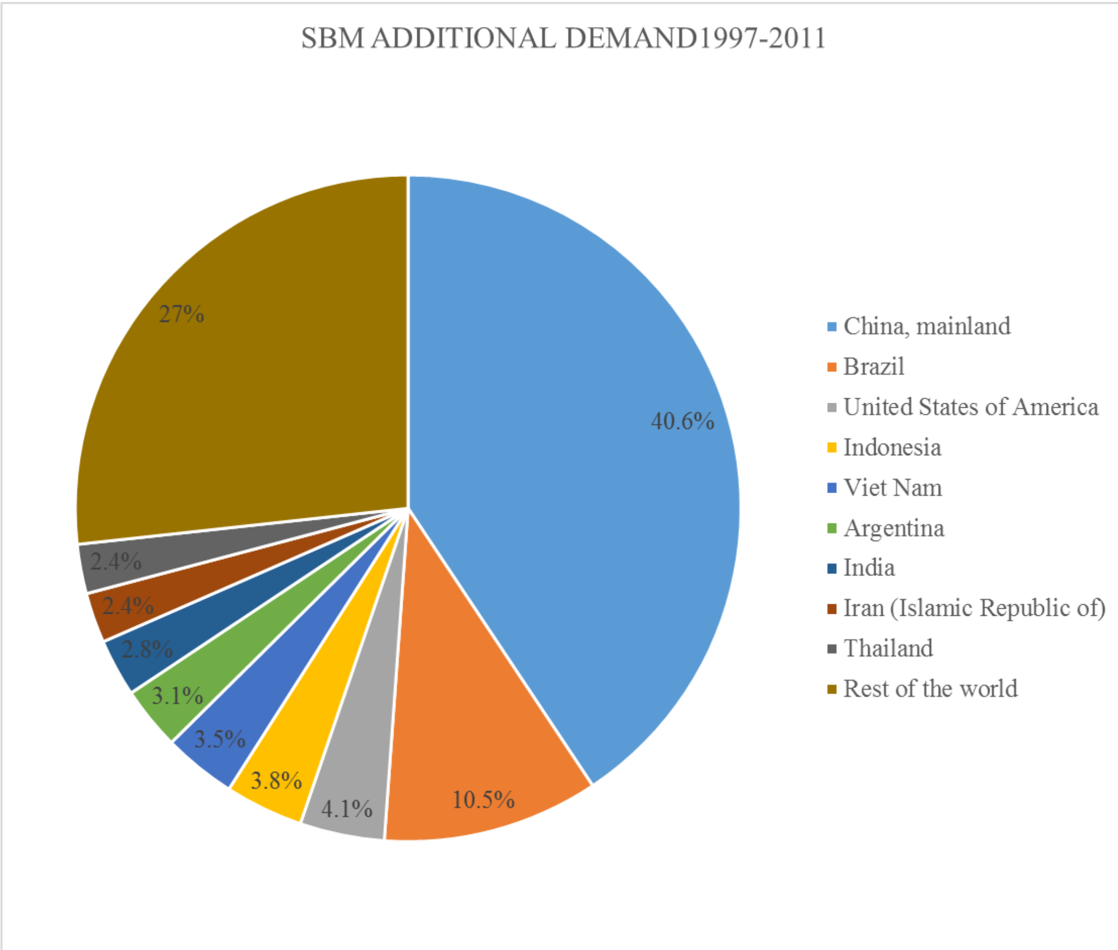
Source: Author’s calculation based on FAO data

Figure 9 Pork additional production 1997-2011



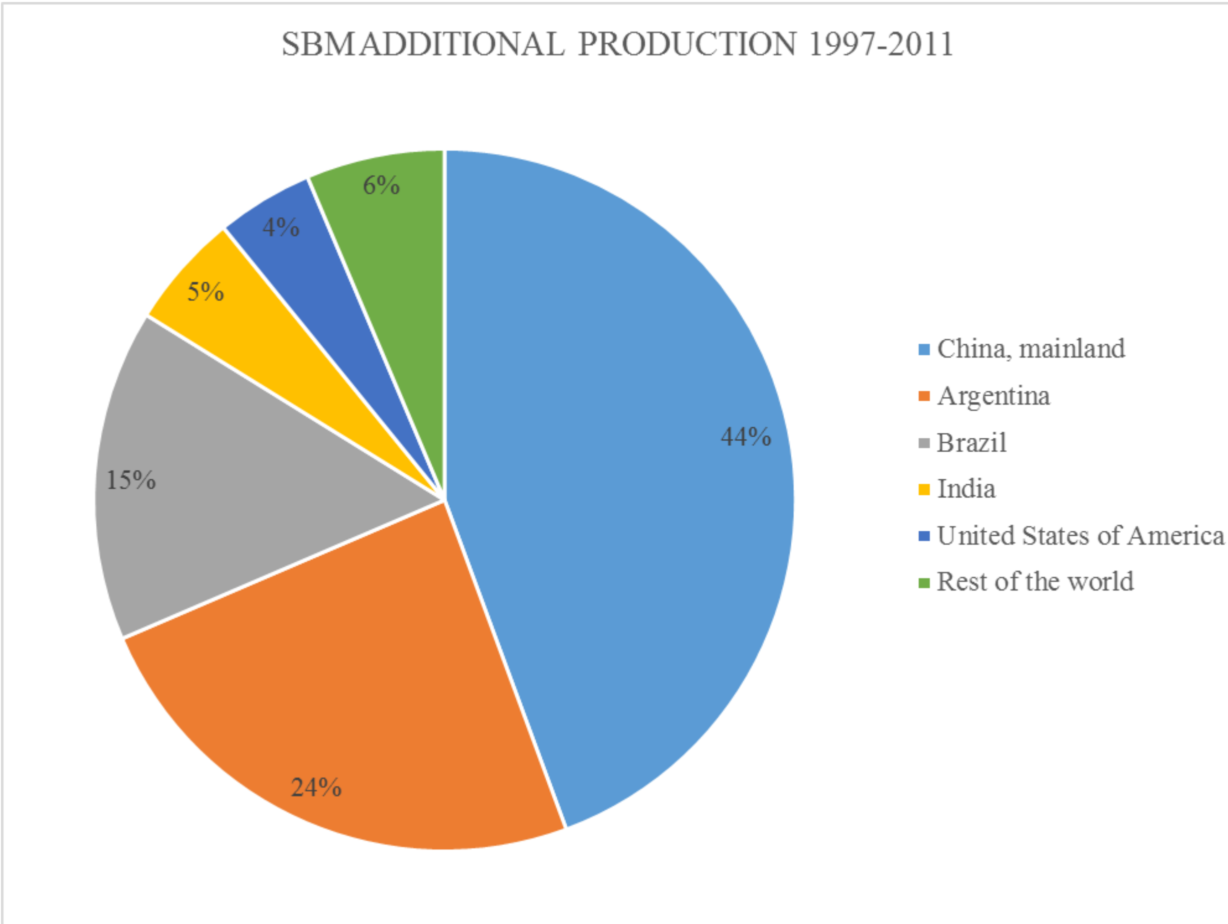
Source: Author's calculation based on FAO data

Figure 10 SBM additional demand 1997-2011



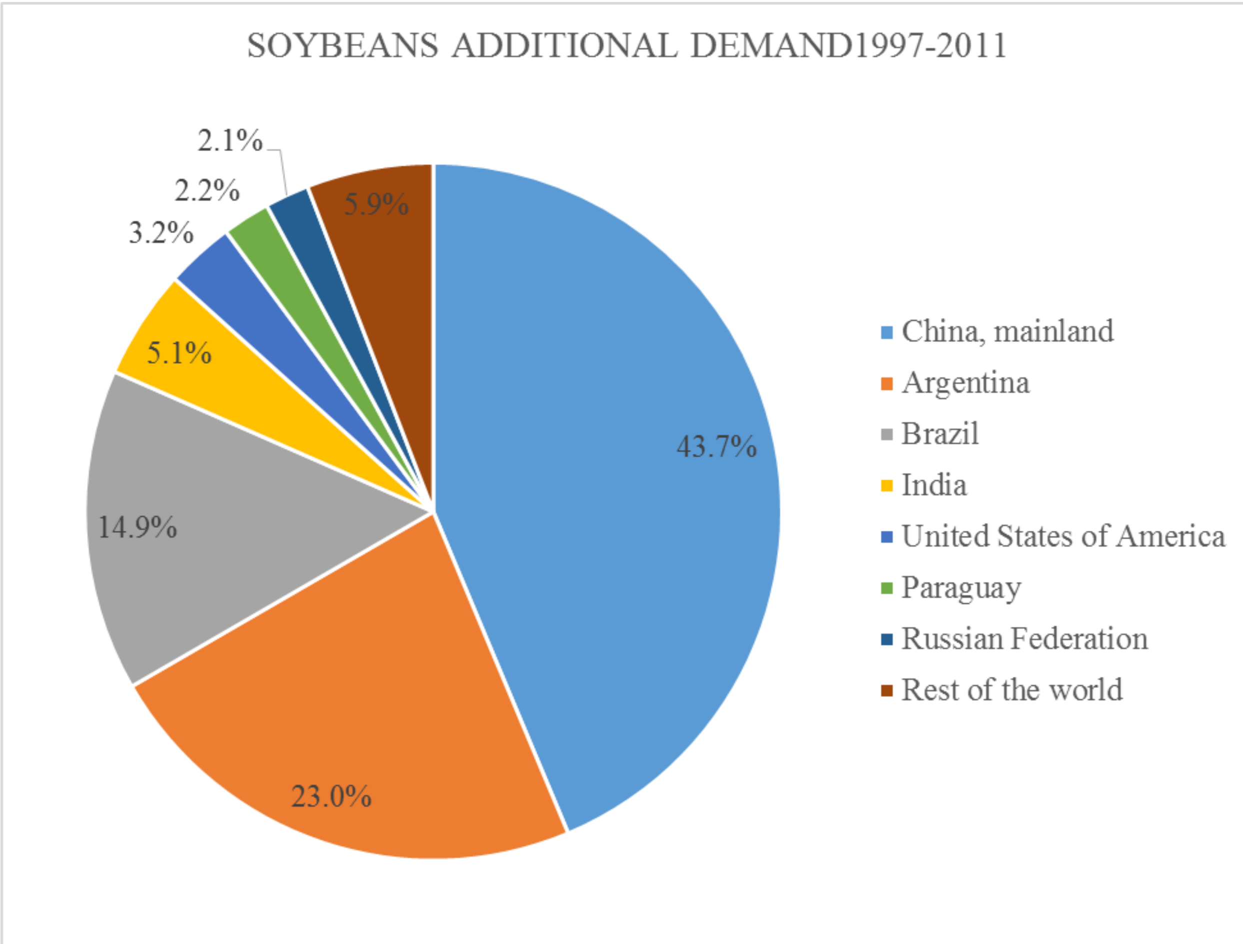
Source: Author’s calculation based on FAO data

Figure 11 SBM additional production 1997-2011



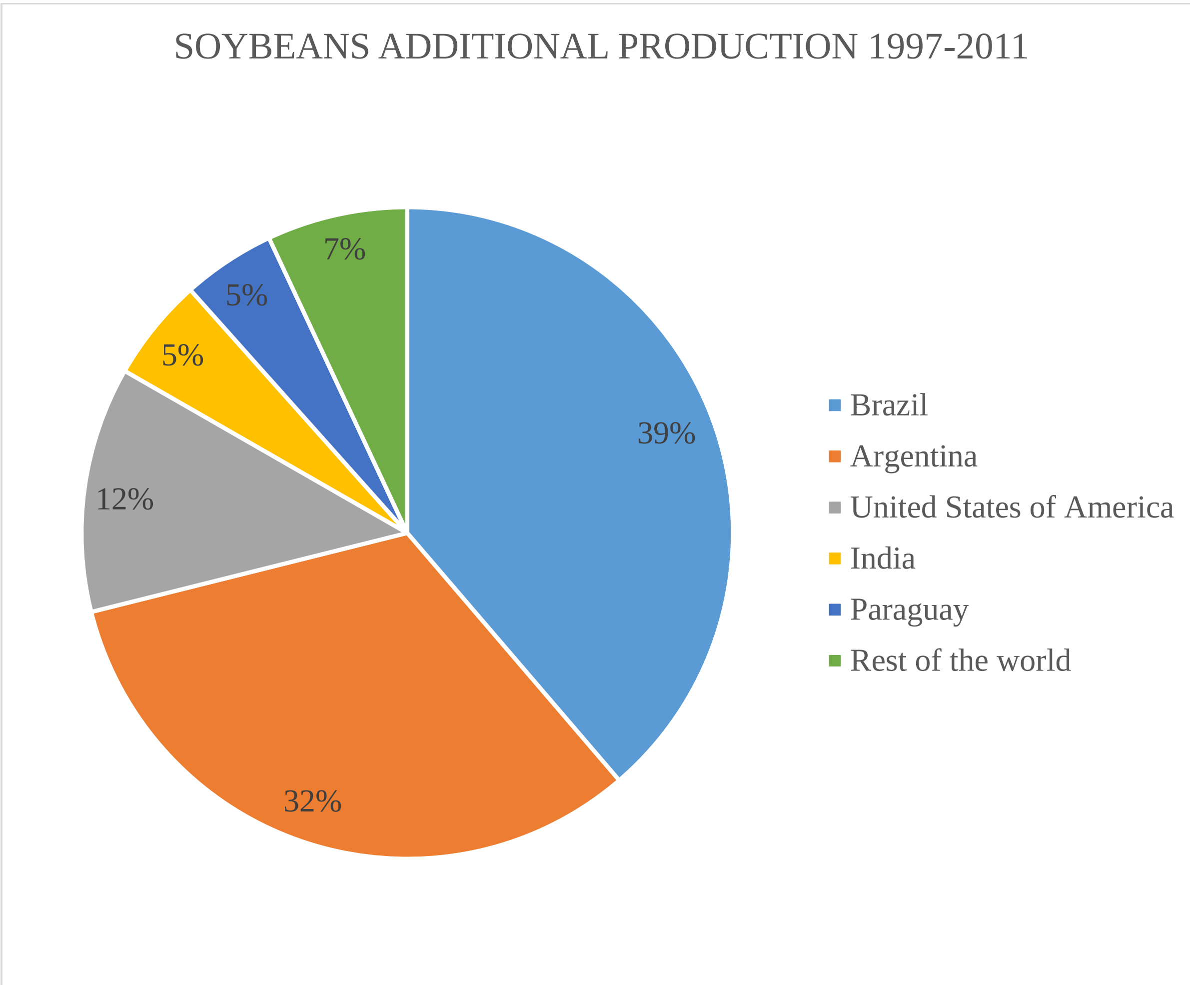
Source: Author’s calculation based on FAO data

Figure 12 Soybeans additional demand 1997-2011



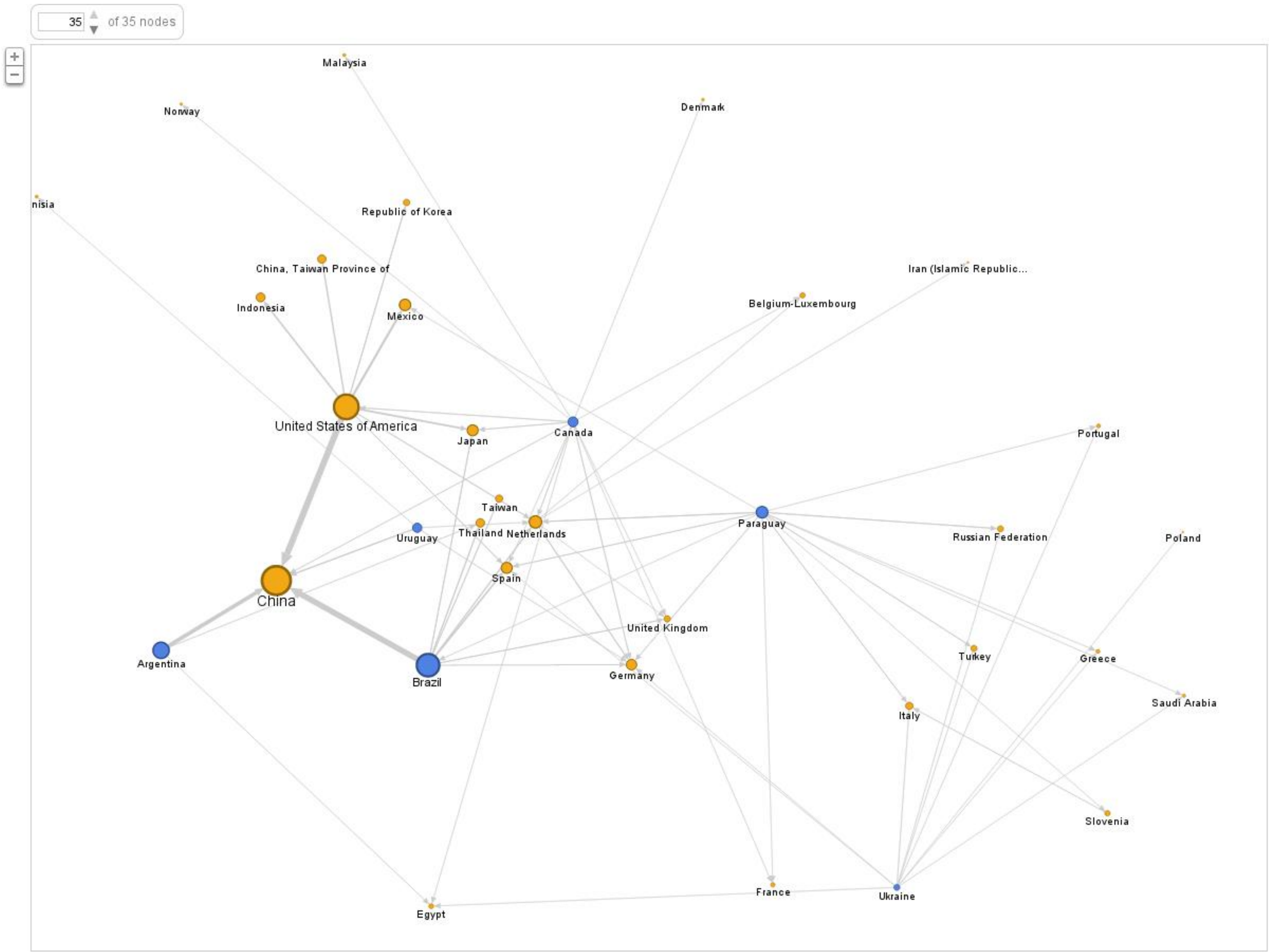
Source: Author's calculation based on FAO data

Figure 13 Soybeans additional production 1997-2011



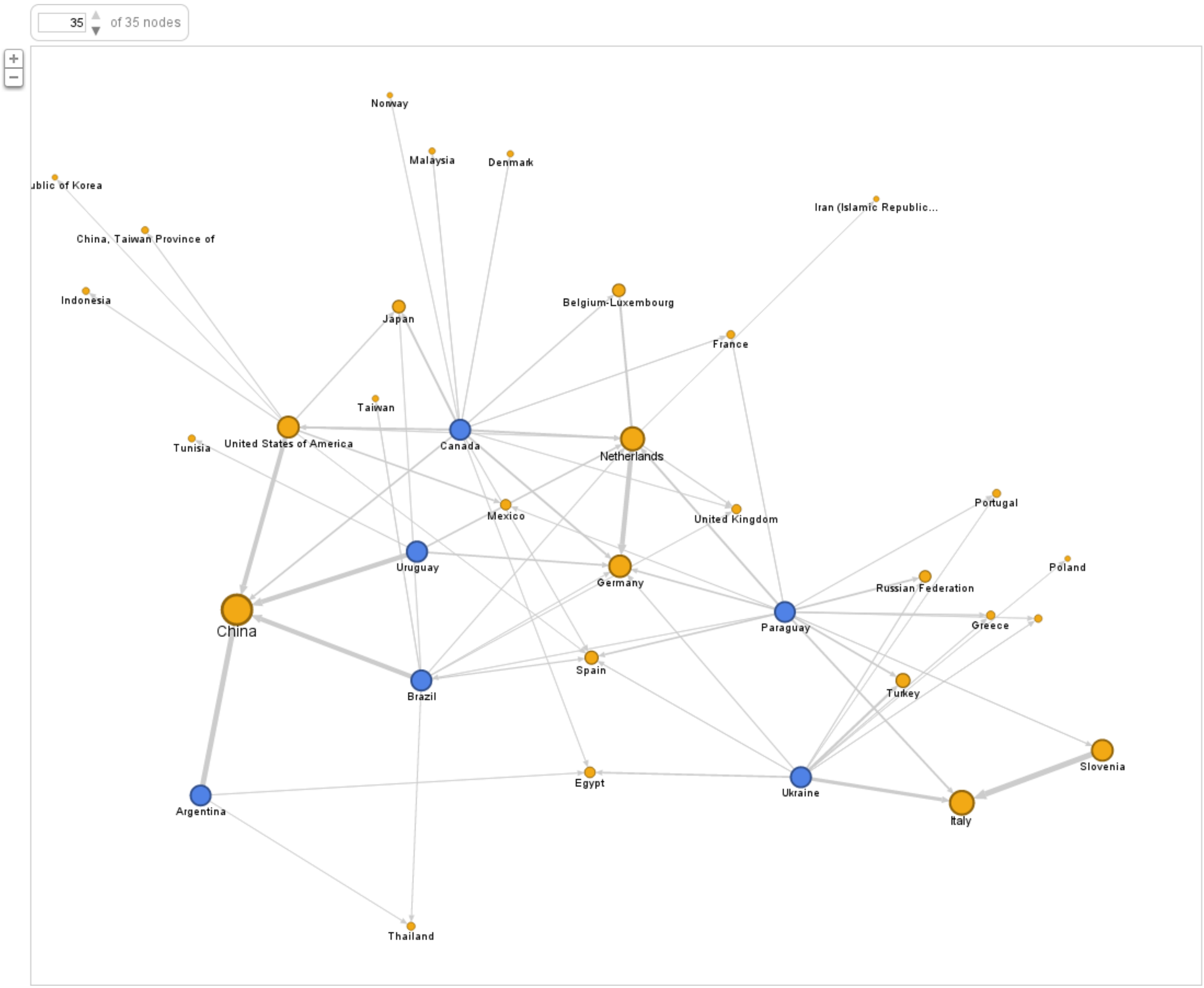
Source: Author’s calculation based on FAO data

Figure 14 Soybean by traded volume 2010/2011



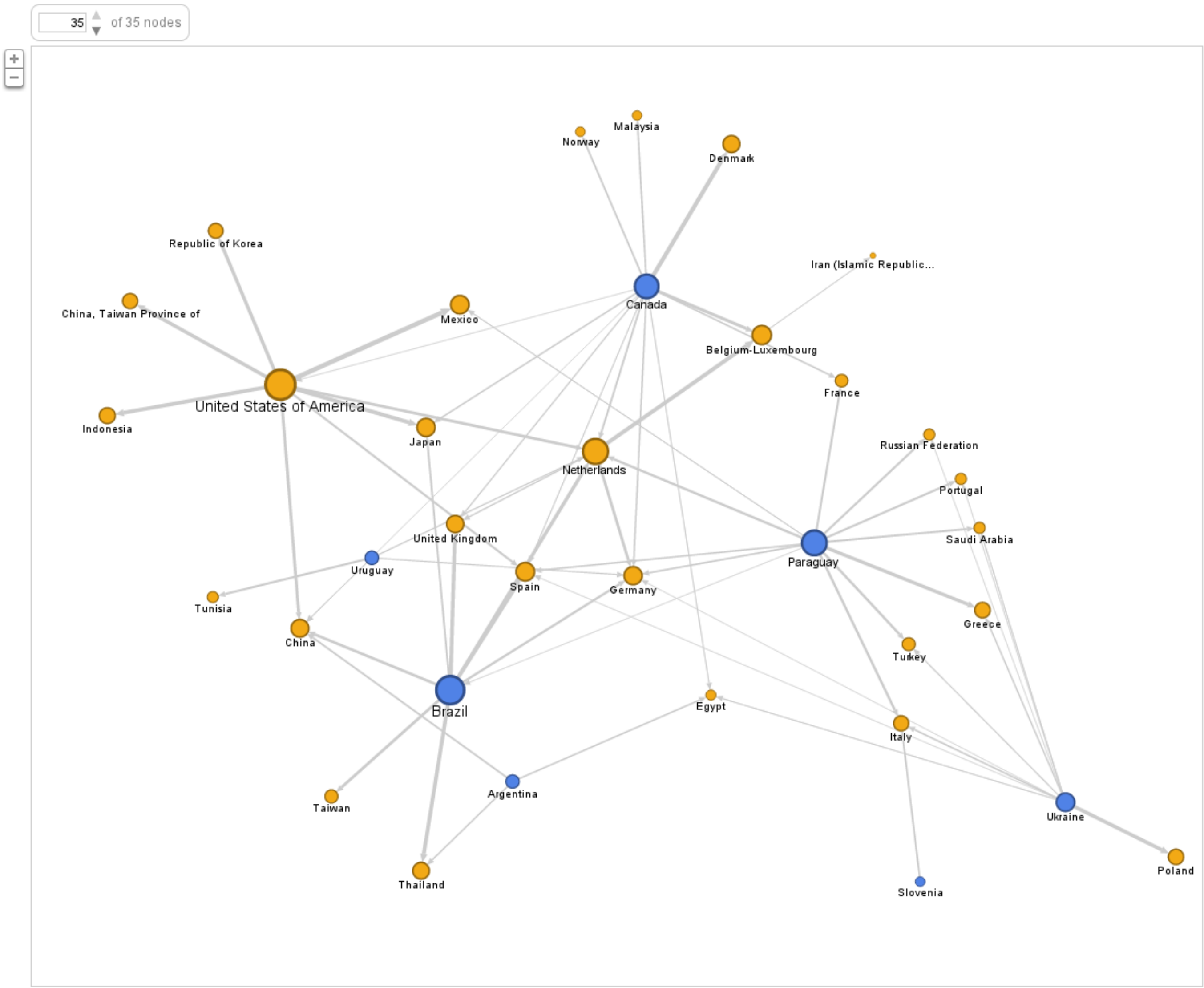
Source: Author's calculation based on FAO data

Figure 15 Soybean by trading partnership 2010/2011



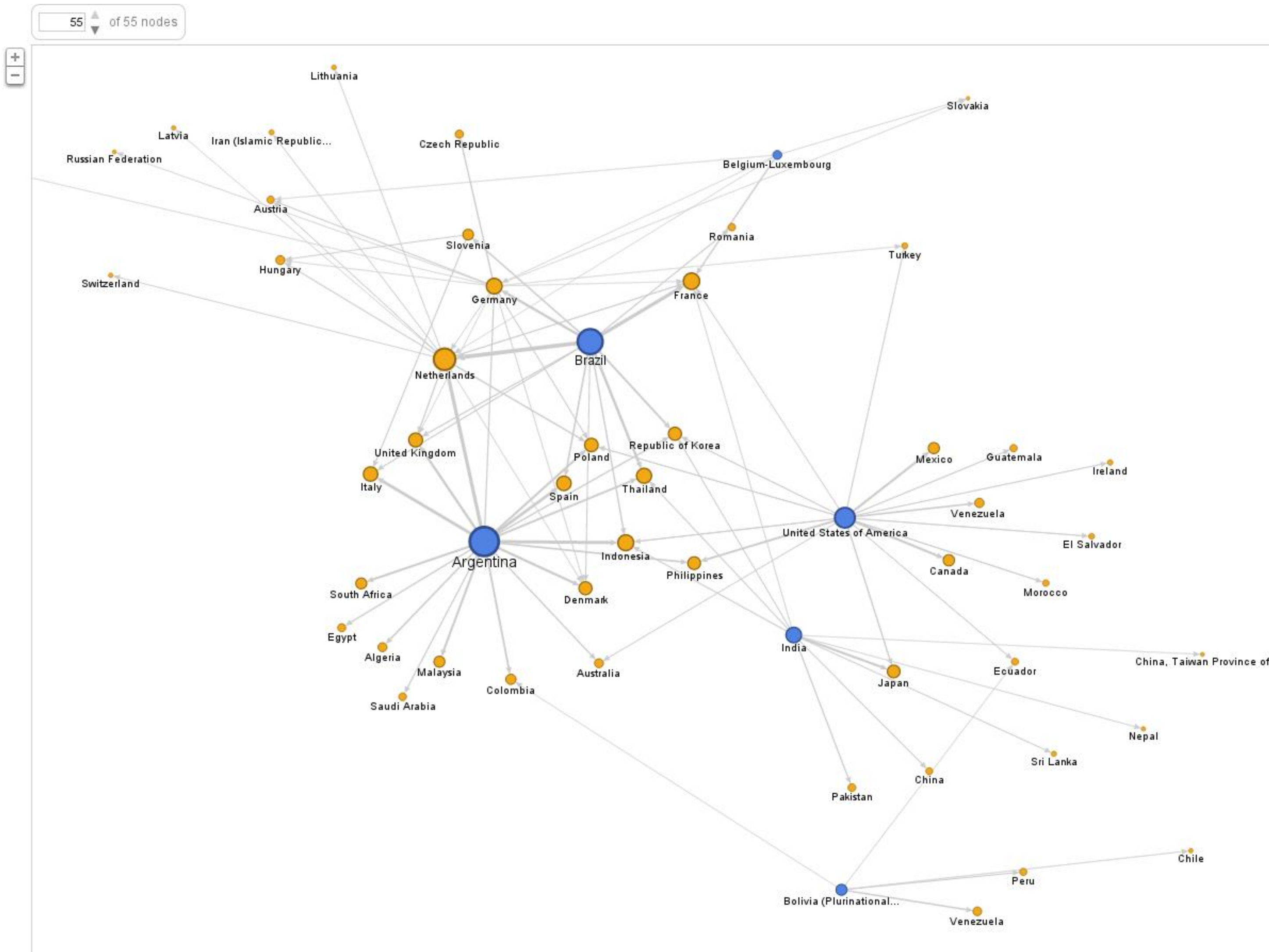
Source: Author's calculation based on FAO data

Figure 16 Soybean by imports dependence 2010/2011



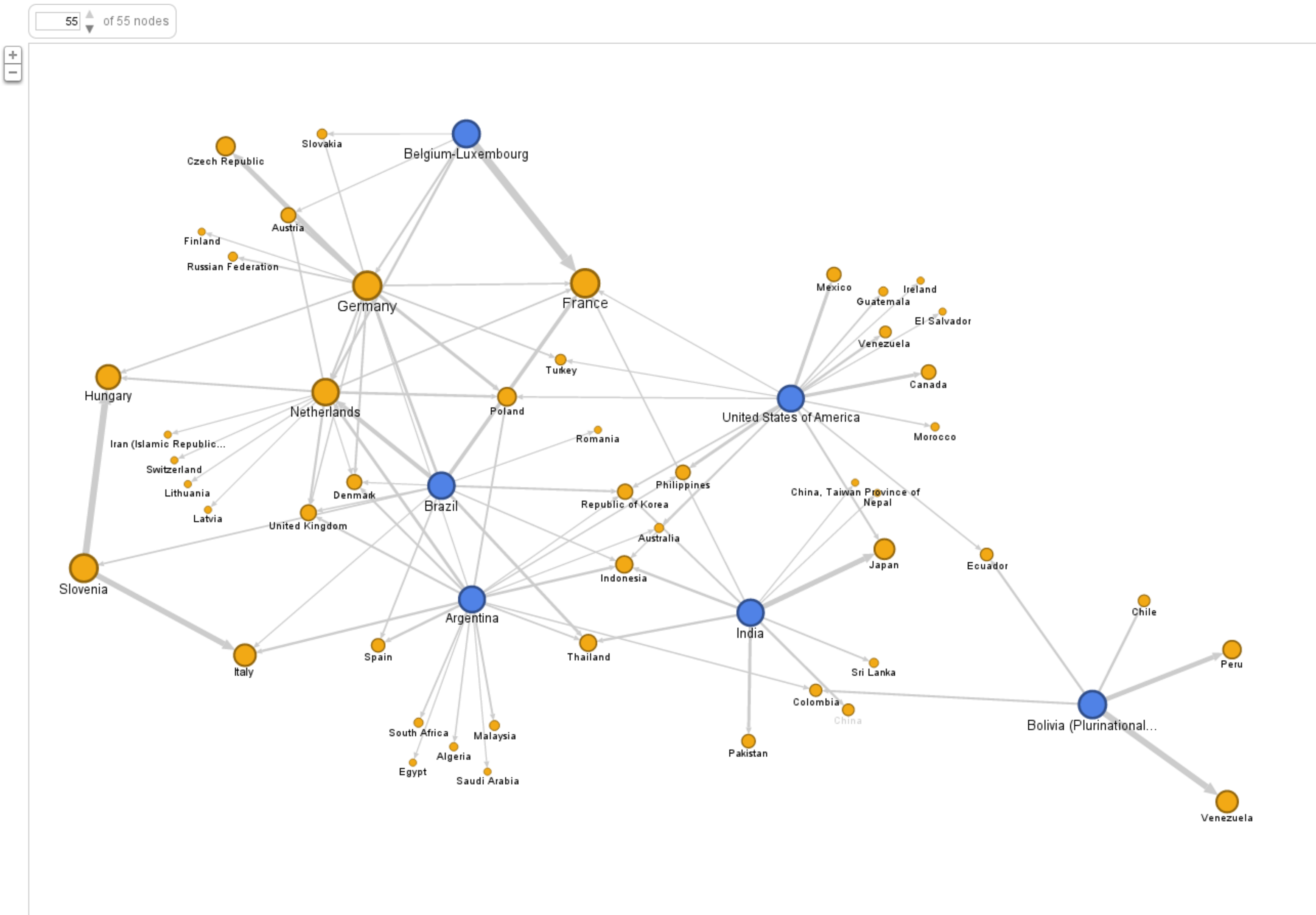
Source: Author's calculation based on FAO data

Figure 17 SBM by traded volume 2010/2011



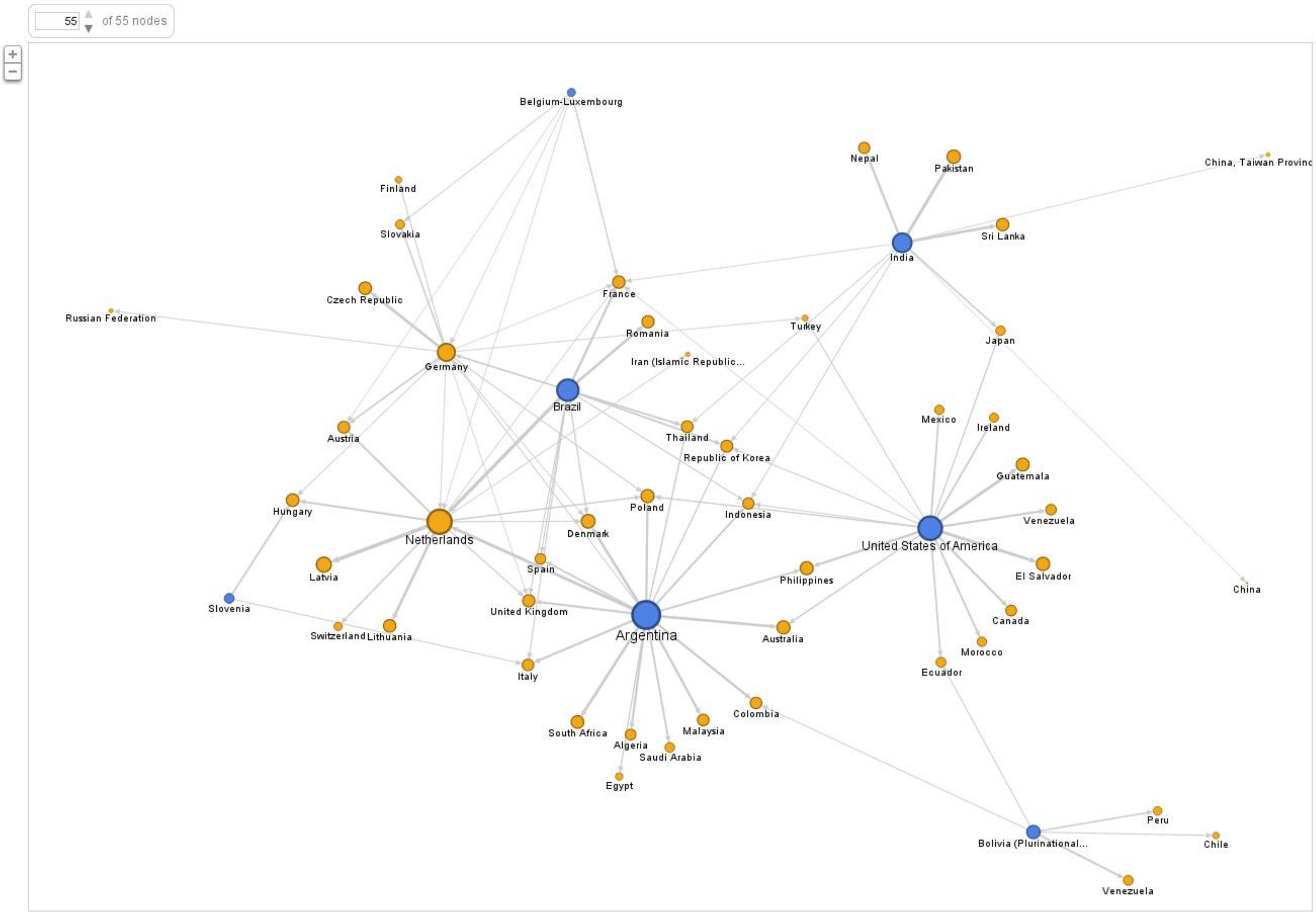
Source: Author's calculation based on FAO data

Figure 18 SBM by trading partnership 2010/2011



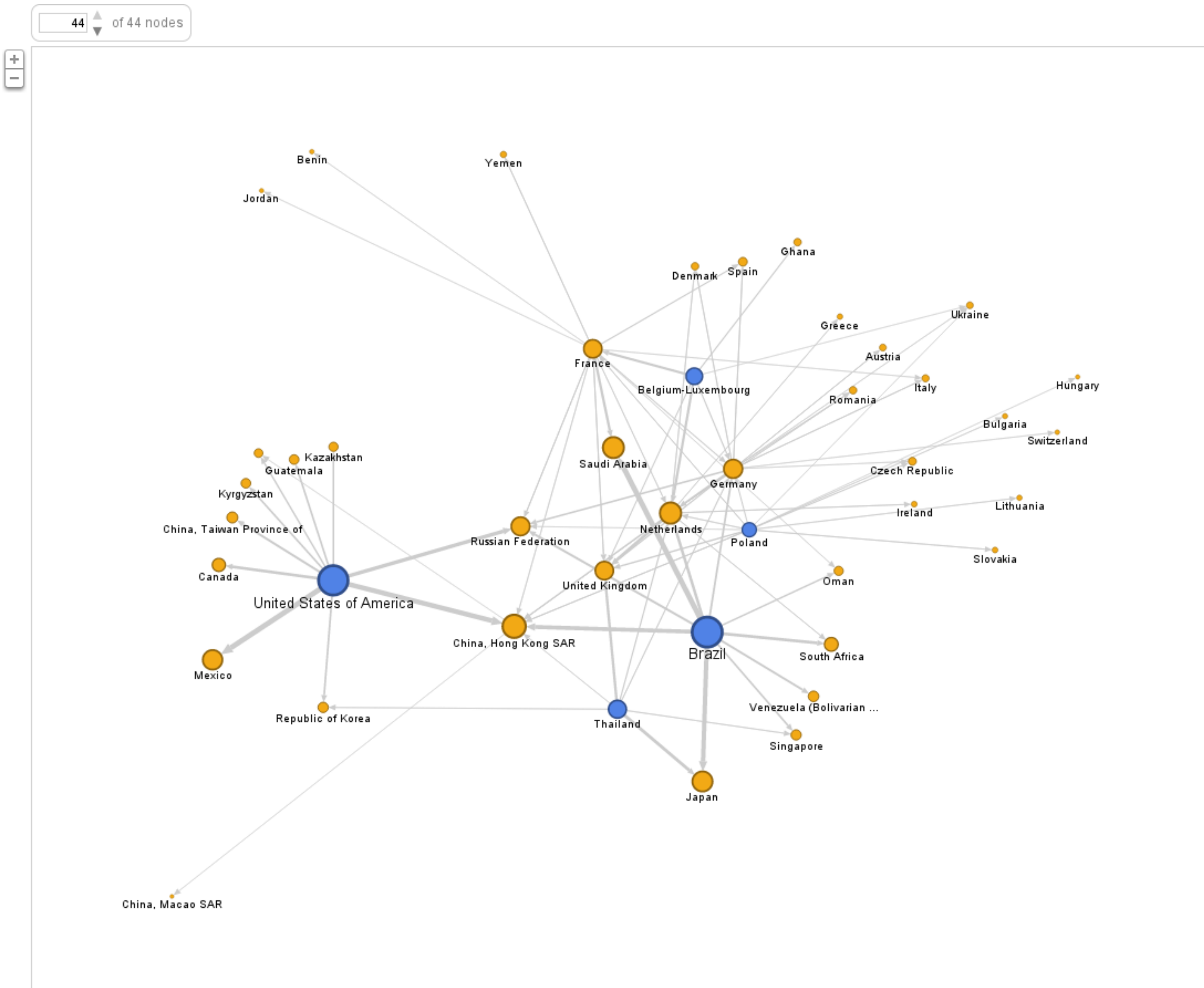
Source: Author’s calculation based on FAO data

Figure 19 SBM by imports dependence 2010/2011



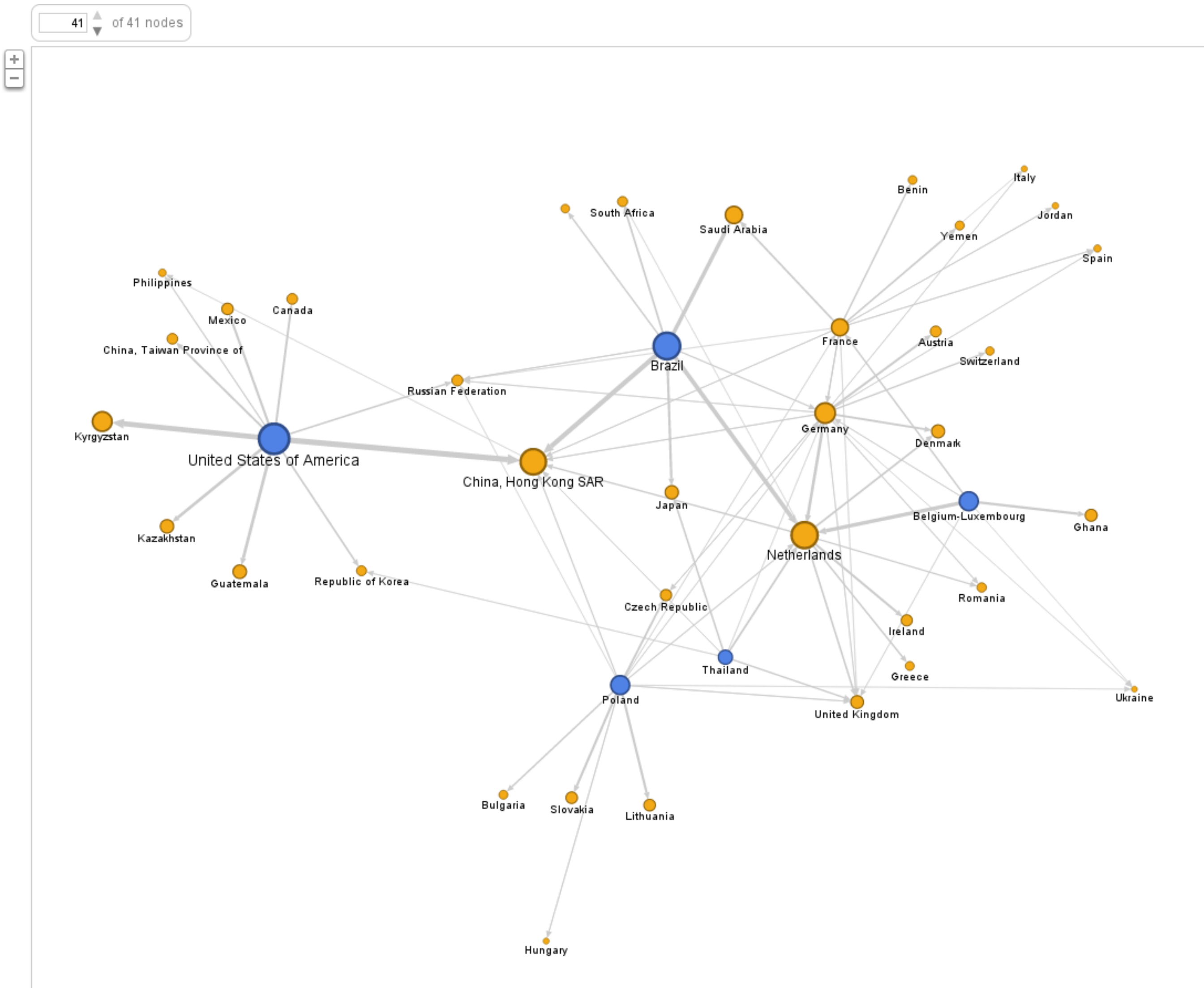
Source: Author's calculation based on FAO data

Figure 20 Poultry by traded volume 2010/2011



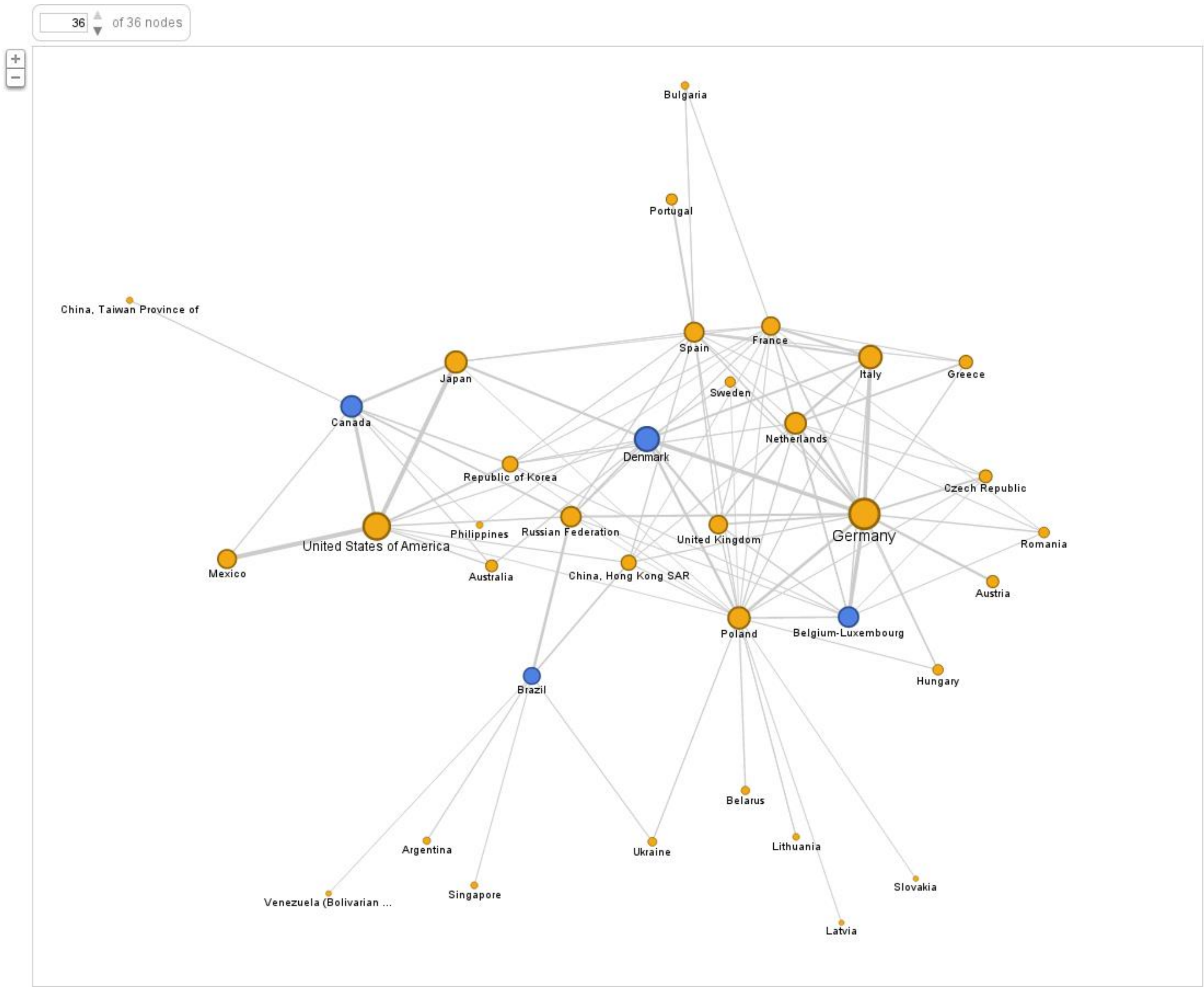
Source: Author's calculation based on FAO data

Figure 21 Poultry by imports dependence 2010/2011



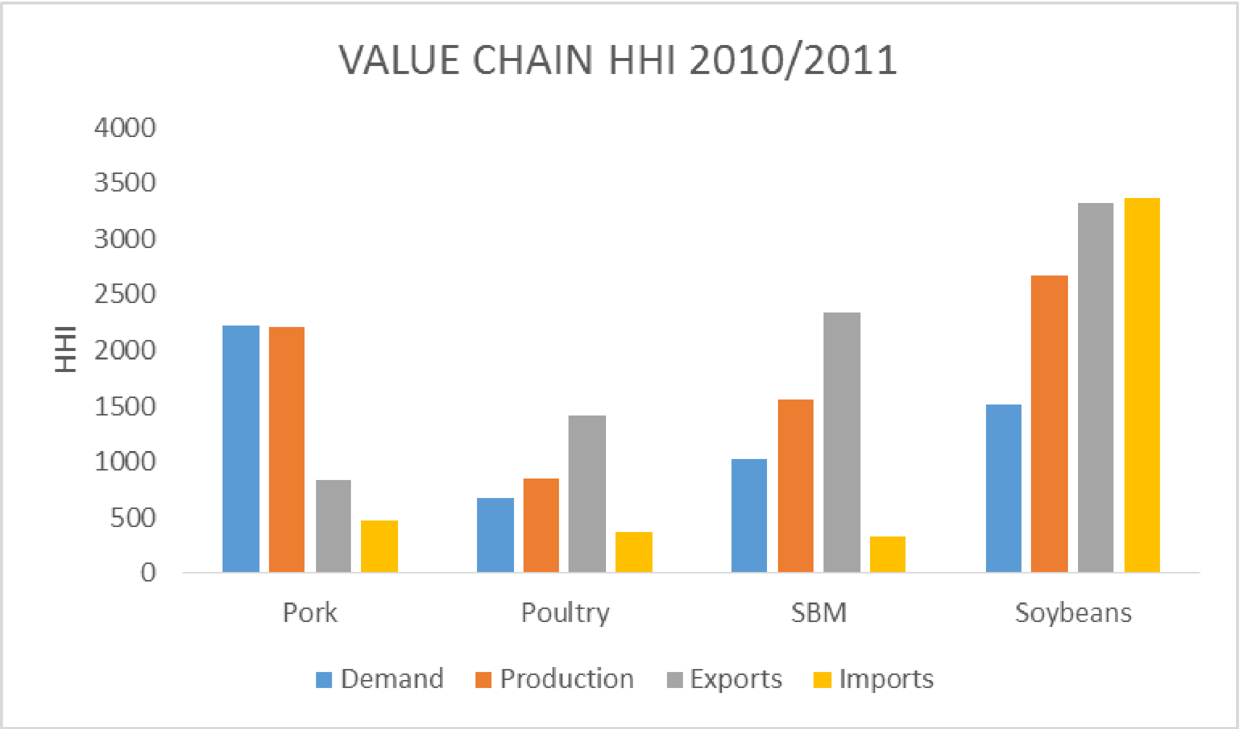
Source: Author's calculation based on FAO data

Figure 22 Pork by traded volume 2010/2011



Source: Author's calculation based on FAO data

Figure 23 Value chain Herfindahl-Hirschman index 2010/2011



Source: Author's calculation based on FAO data

Figure 24 Poultry Herfindahl-Hirschman index 1997-2011

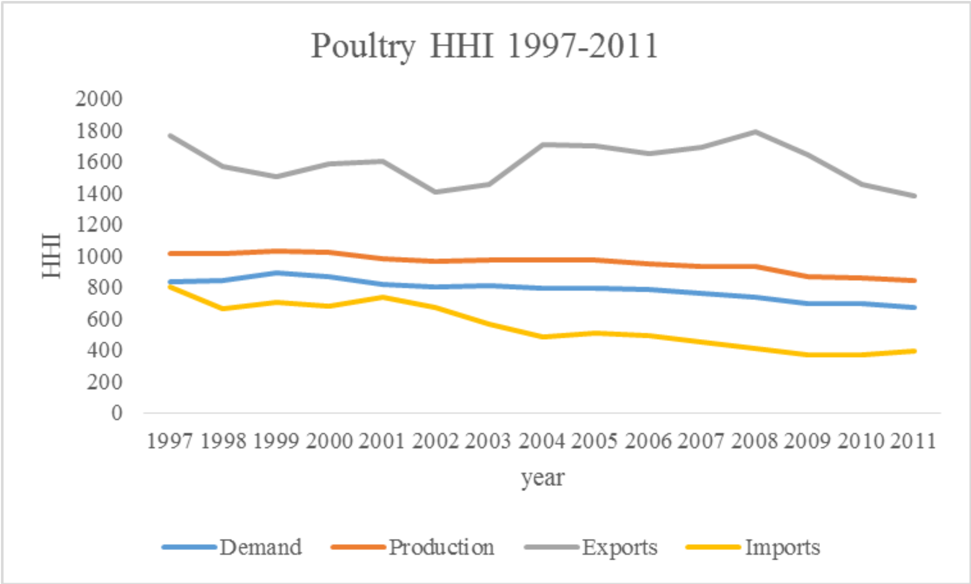
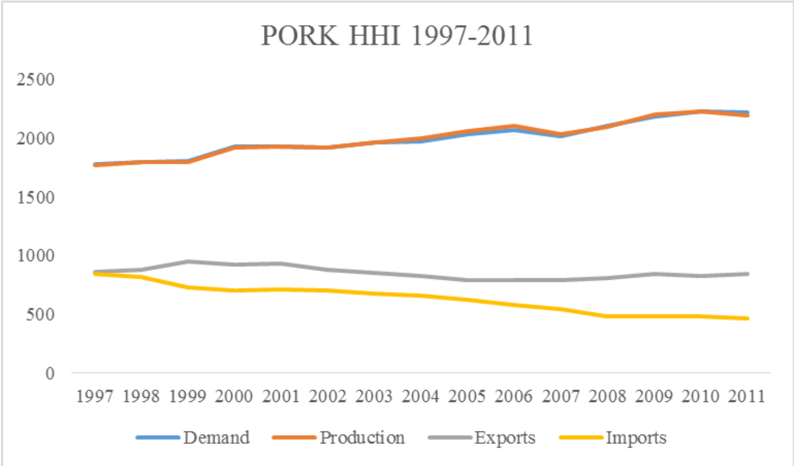


Figure 25 Pork Herfindahl-Hirschman index 1997-2011



Source: Author’s calculation based on FAO data

Figure 26 SBM Herfindahl-Hirschman index 1997-2011

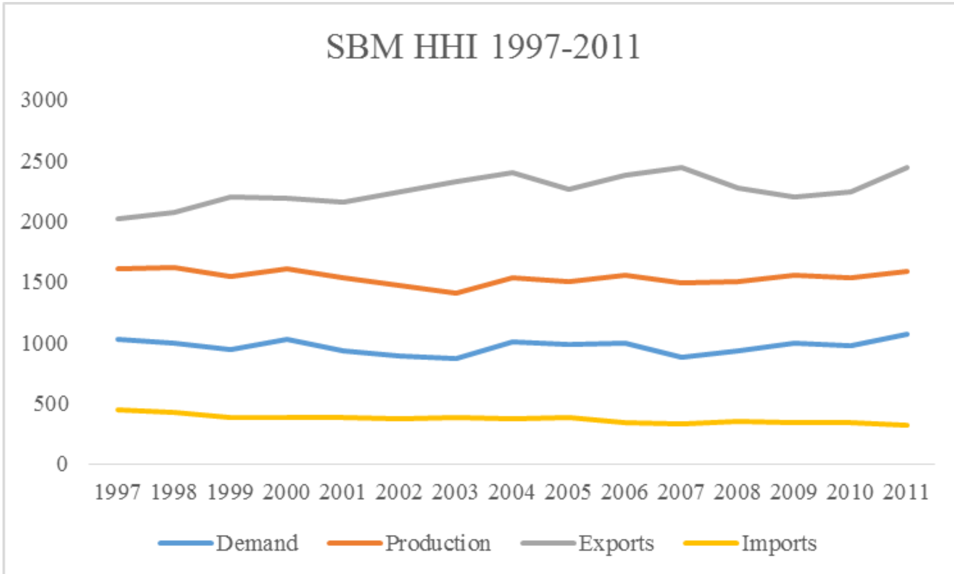
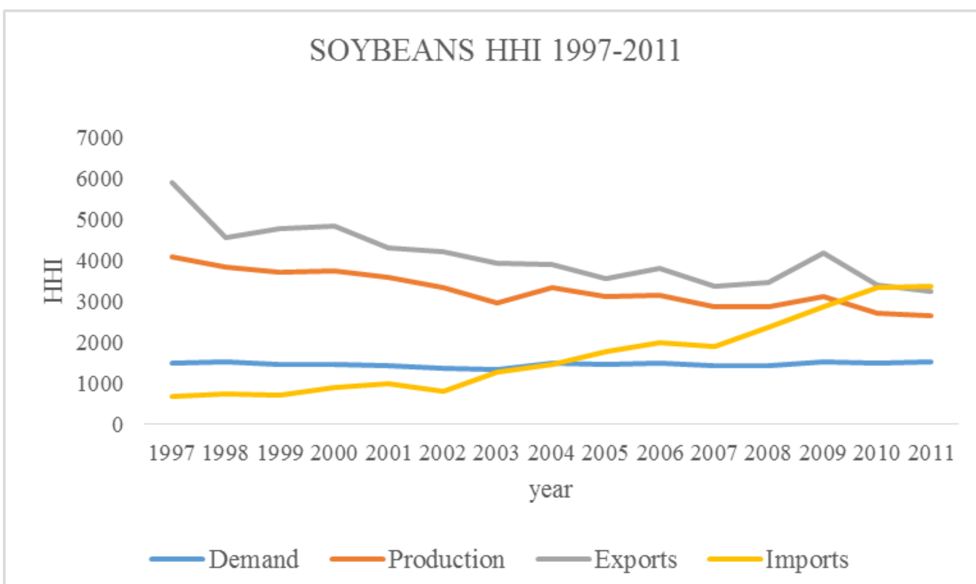


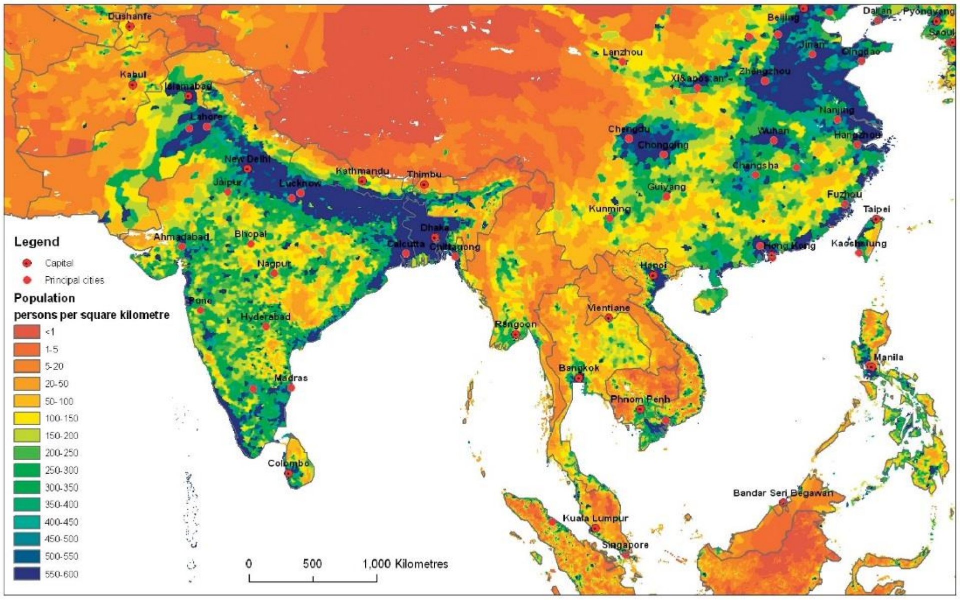
Figure 27 Soybeans Herfindahl-Hirschman index 1997-2011



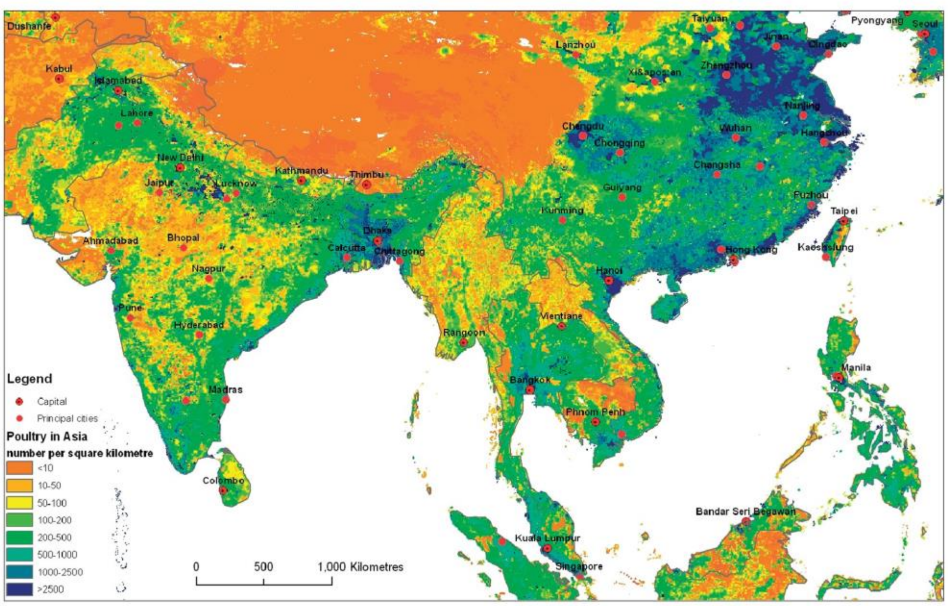
Source: Author's calculation based on FAO data

Figure 28 Poultry and human population concentration in Asia

Human population



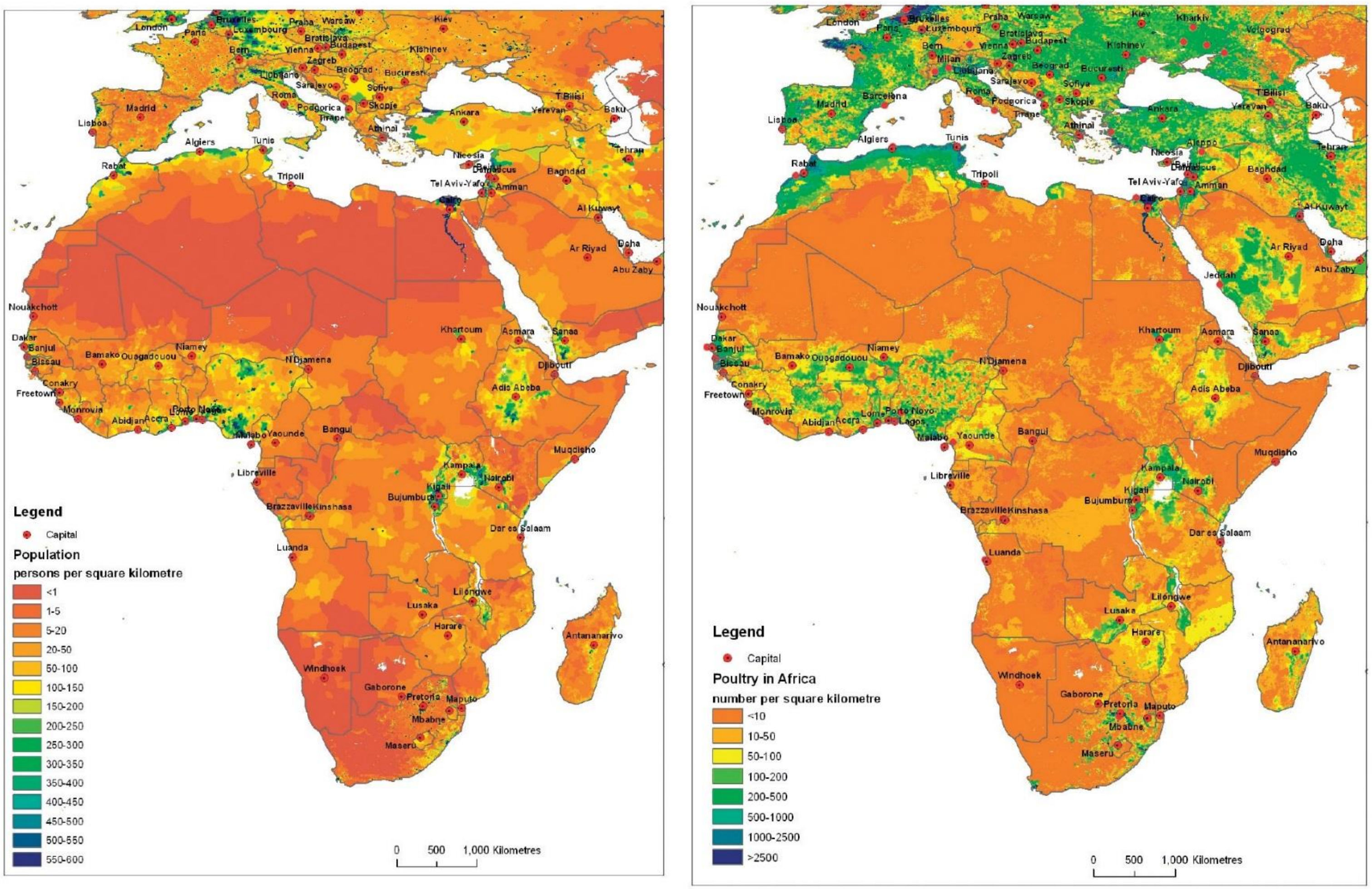
Poultry population



Source: Narrod et al (2008), pag 9

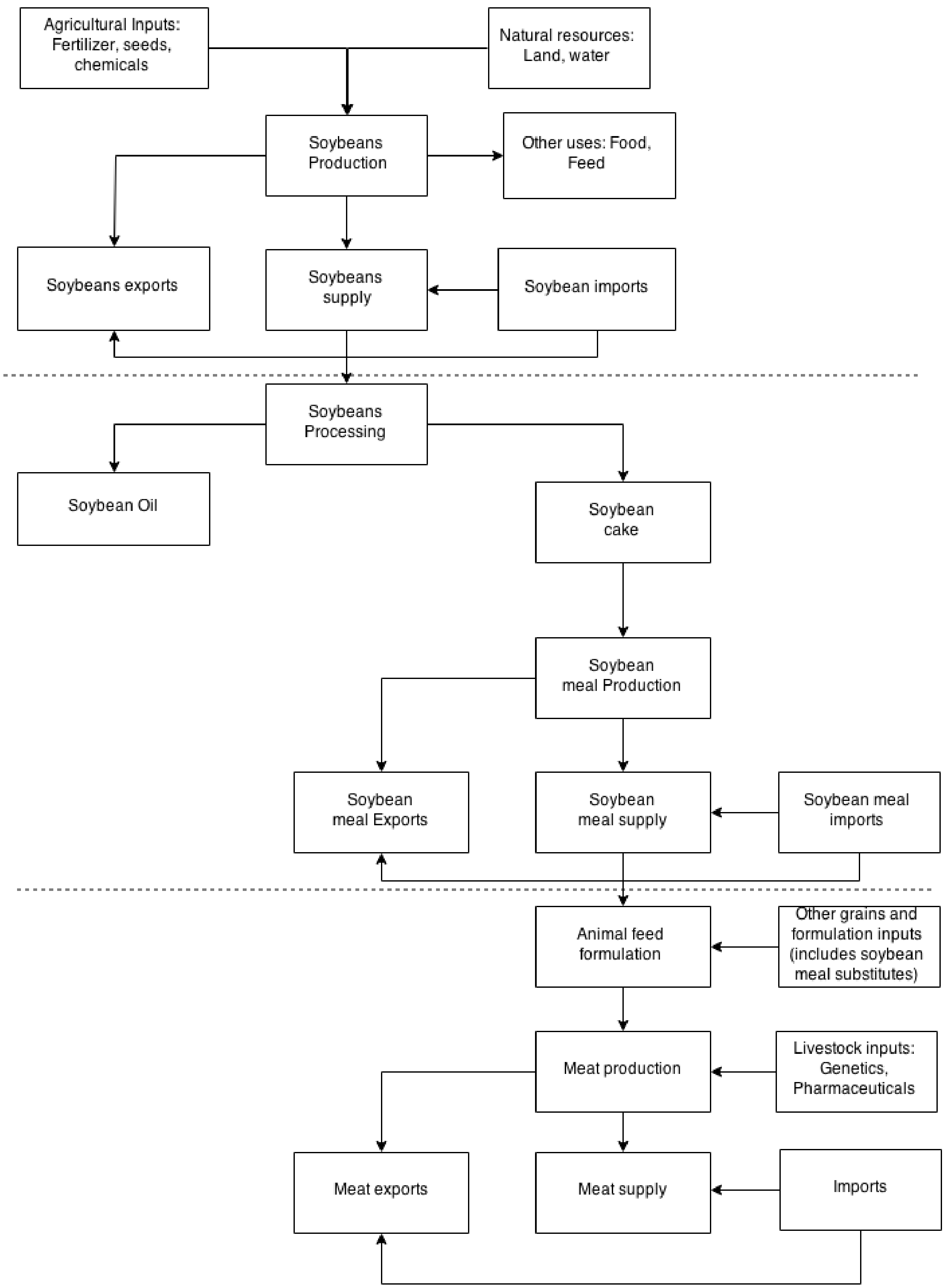
Figure 29 Poultry and human population concentration in Africa

Human population *Poultry population*



Source: Narrod et al (2008), pag 9

Figure 30 Soybean-meat global value chain diagram



Source: Author's

TABLES

Table 1 US broiler performance

Year	Market Age (days)	Market Weight (pounds)	Feed to Meat Gain ratio	Mortality %
1925	112.0	2.5	4.7	18.0
1935	98.0	2.9	4.4	14.0
1940	85.0	2.9	4.0	12.0
1945	84.0	3.0	4.0	10.0
1950	70.0	3.1	3.0	8.0
1955	70.0	3.1	3.0	7.0
1960	63.0	3.4	2.5	6.0
1965	63.0	3.5	2.4	6.0
1970	56.0	3.6	2.3	5.0
1975	56.0	3.8	2.1	5.0
1980	53.0	3.9	2.1	5.0
1985	49.0	4.2	2.0	5.0
1990	48.0	4.4	2.0	5.0
1995	47.0	4.7	2.0	5.0
2000	47.0	5.0	2.0	5.0
2005	48.0	5.4	2.0	4.0
2006	48.0	5.5	2.0	5.0
2007	48.0	5.5	2.0	4.5
2008	48.0	5.6	1.9	4.3
2009	47.0	5.6	1.9	4.1
2010	47.0	5.7	1.9	4.0
2011	47.0	5.8	1.9	3.8

source: US National Chicken council

Table 2 Top 25 countries by per-capita demand of poultry 2010/2011

	COUNTRY	PerCap DEMAND Kg (10/11)
1	Antigua and Barbuda	80.5
2	Saint Kitts and Nevis	77.2
3	China, Hong Kong SAR	73.7
4	Israel	73.7
5	Bahamas	71.2
6	Saint Vincent and the Grenadines	70.4
7	Saint Lucia	69.2
8	Kuwait	68.9
9	Bermuda	68.4
10	Grenada	63.8
11	Trinidad and Tobago	62.6
12	Brunei Darussalam	59.7
13	Samoa	58.1
14	French Polynesia	57.5
15	Dominica	56.0
16	Suriname	55.5
17	Jamaica	55.2
18	Barbados	54.3
19	United States of America	51.4
20	Saudi Arabia	46.7
21	Malaysia	45.1
22	Belize	45.0
23	Venezuela (Bolivarian Republic of)	44.6
24	Australia	42.6
25	New Caledonia	42.2
	WORLD Average	14.5
	WORLD Median	17.7

Table 3 Top 25 countries by rate of growth of poultry demand 1997-2011

COUNTRY	% PerCaP DEMAND GROWTH (97-11)
1 Myanmar	14.2%
2 Ghana	12.6%
3 Angola	12.3%
4 Ukraine	10.7%
5 Kazakhstan	10.3%
6 Viet Nam	10.2%
7 Belarus	8.8%
8 Nicaragua	7.5%
9 India	6.9%
10 Bolivia	6.4%
11 El Salvador	6.3%
12 Benin	6.2%
13 Turkey	6.0%
14 Iran	5.6%
15 Morocco	5.5%
16 Venezuela	5.4%
17 Honduras	5.2%
18 Cuba	5.0%
19 Peru	4.9%
20 Yemen	4.8%
21 Colombia	4.6%
22 Russian Federation	4.6%
23 South Africa	4.4%
24 Sweden	4.1%
25 Libya	0.0%
75 China, Taiwan Province of	-0.1%
76 Italy	-0.2%
77 United Arab Emirates	-0.6%
78 France	-0.6%
79 Thailand	-0.8%
80 Ireland	-0.8%
81 Netherlands	-1.4%
WORLD Average	2.5%

Table 4 Top 25 countries by poultry market size 2010/2011

	COUNTRY	DEMAND (10/11) Tons	%OF WORLD DEMAND	PerCap DEMAND Kg (10/11)	% PerCaP DEMAND GROWTH (97-11)
1	China, mainland	16,642,420	16.7%	12.2	3.4%
2	United States of America	16,122,708	16.2%	51.4	0.9%
3	Brazil	7,683,773	7.7%	39.2	3.3%
4	Mexico	3,470,569	3.5%	29.3	3.5%
5	Russian Federation	3,272,004	3.3%	22.8	4.6%
6	Japan	2,412,542	2.4%	18.9	1.8%
7	India	2,230,593	2.2%	1.8	6.9%
8	United Kingdom	2,016,390	2.0%	32.3	1.4%
9	Iran (Islamic Republic of)	1,917,691	1.9%	25.6	5.6%
10	South Africa	1,757,970	1.8%	34.0	4.4%
11	Indonesia	1,630,414	1.6%	6.7	2.9%
12	Germany	1,556,004	1.6%	18.8	2.6%
13	France	1,534,635	1.5%	24.2	-0.6%
14	Argentina	1,417,491	1.4%	35.0	2.6%
15	Turkey	1,353,560	1.4%	18.6	6.0%
16	Venezuela (Bolivarian Republic of)	1,305,560	1.3%	44.6	5.4%
17	Malaysia	1,286,632	1.3%	45.1	2.1%
18	Saudi Arabia	1,285,377	1.3%	46.7	2.7%
19	Canada	1,265,317	1.3%	36.9	1.0%
20	Viet Nam	1,219,784	1.2%	13.6	10.2%
21	Spain	1,216,311	1.2%	26.2	0.8%
22	Myanmar	1,157,616	1.2%	22.2	14.2%
23	Colombia	1,120,790	1.1%	24.0	4.6%
24	Italy	1,099,772	1.1%	18.1	-0.2%
25	Peru	1,071,367	1.1%	36.4	4.9%
26	Rest of the world	22,365,292	22.5%		
	WORLD	**99,412,575**		**14.5**	**2.5%**

Table 5 Top 25 countries by poultry production 2010/2011

COUNTRY	PRODUCTION (10/11) Tons	%OF WORLD PRODUCTION	% GROWTH (97-11)
United States of America	19,687,812	20%	1.9%
China, mainland	16,682,500	17%	3.8%
Brazil	11,551,880	11%	6.5%
Mexico	2,764,862	3%	4.2%
Russian Federation	2,729,478	3%	10.7%
India	2,237,850	2%	8.6%
Iran (Islamic Republic of)	1,896,841	2%	7.3%
France	1,728,135	2%	-1.9%
Argentina	1,669,035	2%	4.7%
Indonesia	1,629,819	2%	5.6%
United Kingdom	1,564,300	2%	0.1%
Turkey	1,541,769	2%	8.4%
South Africa	1,485,433	1%	5.7%
Germany	1,401,401	1%	4.8%
Japan	1,397,452	1%	1.0%
Thailand	1,320,578	1%	1.1%
Poland	1,277,885	1%	6.9%
Malaysia	1,268,072	1%	4.1%
Canada	1,218,684	1%	1.8%
Italy	1,194,612	1%	0.3%
Spain	1,186,668	1%	1.4%
Myanmar	1,155,697	1%	15.8%
Venezuela (Bolivarian Republic of)	1,120,813	1%	5.9%
Colombia	1,071,039	1%	6.1%
Rest of the world	19,967,143	20%	
WORLD	**100,749,755**		**3.7%**

Table 6 Top 10 countries by poultry imports 2010/2011

COUNTRY	IMPORTS (Tons)	% GROWTH (97-11)	%OF WORLD
China, Hong Kong SAR	1,320,434	4%	9%
Japan	1,022,849	4%	7%
Germany	772,324	4%	6%
United Kingdom	768,678	8%	6%
Saudi Arabia	738,295	9%	5%
Mexico	723,501	7%	5%
Viet Nam	654,602	60%	5%
Netherlands	636,033	9%	5%
Russian Federation	546,666	-6%	4%
China, mainland	481,817	5%	3%
Rest of the world	6,278,810		45%
WORLD	**13,944,008**		

Table 7 Top 10 countries by poultry net imports 2010/2011

COUNTRY	NET IMPORTS (Tons)
Japan	1,015,091
Saudi Arabia	712,377
Mexico	705,707
Viet Nam	654,405
Russian Federation	542,526
China, Hong Kong SAR	531,685
United Kingdom	452,090
Iraq	317,261
United Arab Emirates	293,138
South Africa	271,837

Table 8 Top 10 countries by poultry exports 2010/2011

COUNTRY	EXPORTS (Tons)	% GROWTH (97-11)	%OF WORLD
Brazil	3,869,796	16%	25%
United States of America	3,790,054	3%	25%
Netherlands	1,210,951	5%	8%
China, Hong Kong SAR	788,750	3%	5%
Germany	617,721	13%	4%
France	583,182	-2%	4%
China, mainland	521,898	2%	3%
Thailand	481,741	6%	3%
Belgium-Luxembourg	469,727	4%	3%
Poland	451,861	17%	3%
Rest of the world	2,599,062		17%
WORLD	**15,384,739**		

Table 9 Top 10 countries by poultry net exports 2010/2011

COUNTRY	NET EXPORTS (Tons)
Brazil	3,868,108
United States of America	3,705,105
Netherlands	574,919
Thailand	480,278
Poland	414,061
Belgium - Luxemburg	253,849
Argentina	251,545
France	193,500
Turkey	188,209
Hungary	120,921

Table 10 Top 25 countries by per-capita demand of pork 2010/2011

	COUNTRY	PerCap DEMAND Kg (10/11)
1	China, Hong Kong SAR	79.7
2	Austria	70.1
3	China, Macao SAR	68.1
4	Cyprus	55.8
5	Germany	53.6
6	Poland	53.3
7	Spain	52.7
8	Czech Republic	46.3
9	Estonia	44.3
10	Portugal	44.1
11	Lithuania	43.8
12	Bahamas	43.1
13	Italy	42.3
14	Croatia	41.2
15	China, Taiwan Province of	40.4
16	Hungary	40.4
17	Slovenia	39.0
18	Sweden	39.0
19	Malta	38.5
20	New Caledonia	37.9
21	Latvia	37.1
22	China, mainland	37.1
23	Viet Nam	36.4
24	Finland	36.3
25	Belarus	36.3
	WORLD Average	**16.8**
	WORLD Median	**8.5**

Table 11 Top 25 countries by rate of growth of pork demand 1997-2011

	COUNTRY	% PerCaP DEMAND GROWTH (97-11)
1	Myanmar	11.8%
2	Angola	7.8%
3	Kazakhstan	7.7%
4	Viet Nam	6.9%
5	Croatia	6.7%
6	Cuba	6.7%
7	Latvia	5.7%
8	Colombia	5.4%
9	Guatemala	4.6%
10	Estonia	4.3%
11	Lithuania	4.1%
12	Chile	4.0%
13	Ecuador	3.9%
14	Lao People's Democratic Republic	3.7%
15	South Africa	3.6%
16	Thailand	3.5%
17	Republic of Korea	3.5%
18	Russian Federation	3.4%
19	Dominican Republic	3.2%
20	China, Hong Kong SAR	3.1%
21	Mexico	2.9%
22	China, mainland	2.8%
59	Austria	-0.5%
60	China, Taiwan Province of	-0.5%
61	Paraguay	-0.7%
62	Spain	-0.9%
63	Bulgaria	-1.0%
64	Hungary	-1.0%
65	Malaysia	-1.7%
66	Madagascar	-1.9%
67	Slovakia	-2.0%
68	Mozambique	-2.5%
69	Netherlands	-2.7%
70	India	-3.1%
	WORLD Average	**1.6%**

Table 12 Top 25 countries by pork market size 2010/2011

	COUNTRY	DEMAND (10-11)	%OF WORLD DEMAND	PerCap DEMAND Kg (10/11)	% PerCaP DEMAND GROWTH (97-11)
1	China, mainland	48,670,044	45.7%	37.1	2.8%
2	United States of America	8,841,440	8.3%	30.0	0.2%
3	Germany	4,466,782	4.2%	53.6	0.1%
4	Russian Federation	3,241,914	3.0%	22.3	3.4%
5	Viet Nam	3,059,764	2.9%	36.4	6.9%
6	Japan	2,640,520	2.5%	20.9	1.6%
7	Italy	2,484,883	2.3%	42.3	1.0%
8	Brazil	2,441,555	2.3%	13.4	0.4%
9	Spain	2,263,964	2.1%	52.7	-0.9%
10	France	2,153,831	2.0%	35.3	-0.2%
11	Poland	2,043,738	1.9%	53.3	1.1%
12	Philippines	1,727,850	1.6%	20.6	2.2%
13	Mexico	1,673,843	1.6%	15.3	2.9%
14	United Kingdom	1,639,624	1.5%	27.1	0.7%
15	Republic of Korea	1,507,865	1.4%	32.1	3.5%
16	Canada	985,604	0.9%	30.7	-0.3%
17	China, Taiwan Province of	904,743	0.8%	40.4	-0.5%
18	Thailand	849,752	0.8%	13.3	3.5%
19	Ukraine	770,685	0.7%	16.1	1.1%
20	Indonesia	708,678	0.7%	3.2	0.2%
21	Romania	651,390	0.6%	29.3	0.2%
22	Myanmar	602,647	0.6%	12.1	11.8%
23	Austria	575,288	0.5%	70.1	-0.5%
24	Netherlands	567,462	0.5%	33.7	-2.7%
25	China, Hong Kong SAR	543,393	0.5%	79.7	3.1%
26	Rest of the world	10,568,366	9.9%		
	WORLD	**106,585,618**		**16.8**	**1.6%**

Table 13 Top 25 countries by pork production 2010/2011

	COUNTRY	PRODUCTION (10/11) Tons	%OF WORLD PRODUCTION	% GROWTH (97-11)
1	China, mainland	48,503,500	45.2%	3.0%
2	United States of America	10,258,280	9.6%	1.6%
3	Germany	5,552,222	5.2%	2.9%
4	Spain	3,419,133	3.2%	2.1%
5	Brazil	3,211,000	3.0%	2.7%
6	Viet Nam	3,067,629	2.9%	7.0%
7	Russian Federation	2,379,221	2.2%	3.2%
8	France	2,236,319	2.1%	-0.1%
9	Canada	1,947,405	1.8%	2.8%
10	Poland	1,915,550	1.8%	-0.2%
11	Denmark	1,694,200	1.6%	0.5%
12	Philippines	1,639,070	1.5%	2.9%
13	Italy	1,637,439	1.5%	1.1%
14	Netherlands	1,320,685	1.2%	-1.1%
15	Japan	1,279,890	1.2%	-0.1%
16	Mexico	1,188,290	1.1%	1.6%
17	Belgium-Luxembourg	1,126,045	1.0%	0.4%
18	Republic of Korea	973,500	0.9%	0.4%
19	Thailand	864,666	0.8%	4.0%
20	China, Taiwan Province of	855,128	0.8%	-0.8%
21	United Kingdom	782,000	0.7%	-2.5%
22	Indonesia	708,015	0.7%	0.9%
23	Austria	674,000	0.6%	0.4%
24	Ukraine	667,800	0.6%	-0.2%
25	Myanmar	602,200	0.6%	12.2%
	Rest of the world	8,825,008	8.2%	
	WORLD	**107,328,193**		**2.2%**

Table 14 Top 10 countries by pork exports 2010/2011

COUNTRY	EXPORTS (Tons)	% GROWTH (97-11)	%OF WORLD
Germany	2,345,194	16%	16%
United States of America	1,788,196	10%	12%
Denmark	1,728,304	2%	12%
Spain	1,282,829	11%	9%
Canada	1,190,517	7%	8%
Netherlands	1,100,792	3%	7%
Belgium-Luxembourg	911,213	1%	6%
Brazil	770,534	15%	5%
France	676,590	1%	5%
Poland	448,754	4%	3%
Rest of the world	2,651,576		18%
WORLD	**14,894,496**		

Table 15 Top 10 countries by pork net exports 2010/2011

COUNTRY	NET EXPORTS
Denmark	1,579,459
United States of America	1,411,840
Spain	1,145,170
Germany	1,085,440
Canada	961,801
Brazil	769,445
Netherlands	750,640
Belgium-Luxembourg	713,072
Chile	123,598
Austria	98,712
France	82,488
Ireland	82,039
Hungary	33,750
Belarus	23,120
Thailand	**14,915**

Table 16 Top 10 countries by pork imports 2010/2011

COUNTRY	IMPORTS (Tons)	% GROWTH (97-11)	%OF WORLD
Japan	1,361,585	4%	10%
Germany	1,259,755	2%	9%
Italy	1,115,934	3%	8%
United Kingdom	1,078,057	5%	8%
Russian Federation	907,669	1%	6%
China, Hong Kong SAR	610,310	9%	4%
France	594,102	2%	4%
Mexico	581,716	12%	4%
Poland	576,941	20%	4%
Republic of Korea	535,021	14%	4%
Rest of the world	5,562,509		39%
WORLD	**14,183,596**		

Table 17 Top 10 countries by pork net imports 2010/2011

COUNTRY	NET IMPORTS
Japan	1,360,631
Russian Federation	862,694
United Kingdom	857,624
Italy	847,445
Republic of Korea	534,365
Mexico	485,553
China, Hong Kong SAR	420,543
Greece	250,301
Romania	209,737
Czech Republic	199,407
Australia	173,520
China, mainland	166,544
Bulgaria	132,342
Poland	128,188
Slovakia	113,529

Table 18 Top 25 countries by SBM market size 2010/2011

COUNTRY	DEMAND (10/11) Tons	%OF WORLD DEMAND	% GROWTH (97-11)
China, mainland	41,587,894	24.0%	9.5%
United States of America	28,835,985	16.7%	0.8%
Brazil	13,680,260	7.9%	6.1%
Indonesia	4,747,911	2.7%	6.6%
Spain	4,451,465	2.6%	1.2%
Germany	4,225,000	2.4%	0.9%
India	4,036,858	2.3%	5.2%
Japan	3,921,193	2.3%	0.4%
France	3,858,790	2.2%	-0.1%
Thailand	3,622,344	2.1%	4.9%
Italy	3,326,972	1.9%	0.8%
Argentina	2,966,727	1.7%	10.6%
Viet Nam	2,831,521	1.6%	24.6%
Mexico	2,810,680	1.6%	2.7%
United Kingdom	2,545,653	1.5%	2.0%
Netherlands	2,466,135	1.4%	3.6%
Iran (Islamic Republic of)	2,371,218	1.4%	10.5%
Republic of Korea	2,256,697	1.3%	2.2%
Egypt	2,101,247	1.2%	8.1%
Canada	1,985,799	1.1%	0.4%
Poland	1,883,313	1.1%	5.7%
China, Taiwan Province of	1,864,940	1.1%	2.4%
Turkey	1,684,761	1.0%	7.5%
Philippines	1,571,179	0.9%	3.0%
Russian Federation	1,544,008	0.9%	15.9%
Rest of the world	25,992,250	15%	
WORLD	**173,170,795**		**4.2%**

Table 19 Top 25 countries by SBM production 2010/2011

	COUNTRY	PRODUCTION (10/11) Tons	%OF WORLD PRODUCTION	% GROWTH (97-11)
1	China, mainland	42,093,060	24.0%	12.5%
2	United States of America	36,250,300	20.7%	0.7%
3	Argentina	28,858,630	16.5%	7.6%
4	Brazil	27,660,000	15.8%	4.0%
5	India	8,895,600	5.1%	4.4%
6	Spain	2,520,890	1.4%	1.1%
7	Germany	2,388,150	1.4%	-1.6%
8	Indonesia	1,844,196	1.1%	3.2%
9	Mexico	1,808,000	1.0%	-0.2%
10	China, Taiwan Province of	1,805,940	1.0%	2.2%
11	Netherlands	1,798,950	1.0%	-4.0%
12	Japan	1,725,991	1.0%	-3.5%
13	Paraguay	1,446,864	0.8%	7.7%
14	Egypt	1,379,320	0.8%	19.2%
15	Italy	1,251,450	0.7%	0.5%
16	Bolivia (Plurinational State of)	1,229,561	0.7%	4.7%
17	Turkey	1,218,197	0.7%	12.5%
18	Thailand	1,115,500	0.6%	4.1%
19	Russian Federation	1,088,322	0.6%	20.8%
20	Canada	1,056,600	0.6%	-0.9%
21	Iran (Islamic Republic of)	681,375	0.4%	12.2%
22	Republic of Korea	672,200	0.4%	-1.8%
23	Portugal	548,300	0.3%	3.0%
24	United Kingdom	509,250	0.3%	-0.9%
	Rest of the world	5,452,481	3%	
	WORLD	**175,301,136**		**4.2%**

Table 20 Top countries by SBM exports 2010/2011

COUNTRY	EXPORTS (Tons)	% GROWTH (97-11)	%OF WORLD
Argentina	25,892,185	8.3%	40%
Brazil	14,011,885	2.4%	22%
United States of America	7,528,093	0.3%	12%
Netherlands	4,919,379	5.2%	8%
India	4,859,156	4.4%	8%
Germany	1,289,362	0.1%	2%
Paraguay	1,081,400	6.5%	2%
Bolivia (Plurinational State of)	1,061,137	6.5%	2%
Slovenia	830,035	144.8%	1%
China, mainland	711,163	22.4%	1%
Belgium-Luxembourg	589,095	-3.1%	1%
Rest of the world	1,916,638		3%
WORLD	**64,689,526**		

Table 21 Top countries by SBM net exports 2010/2011

COUNTRY	NET EXPORTS (Tons)
Argentina	25,891,901
Brazil	13,979,745
United States of America	7,414,315
India	4,858,742
Paraguay	1,081,400
Bolivia	1,061,135
China, mainland	505,167

Table 22 Top countries by SBM imports 2010/2011

COUNTRY	IMPORTS (Tons)	% GROWTH (97-11)	%OF WORLD
Netherlands	5,586,564	17.5%	9%
France	3,569,034	0.4%	6%
Germany	3,436,391	5.1%	5%
Indonesia	2,903,716	8.5%	5%
Viet Nam	2,773,033	23.8%	4%
Thailand	2,507,106	3.2%	4%
Italy	2,244,179	2.2%	4%
Spain	2,243,839	2.7%	4%
Japan	2,195,284	7.0%	3%
United Kingdom	2,099,355	2.8%	3%
Poland	1,917,318	6.9%	3%
Rest of the world	31,400,328		50%
WORLD	**62,876,143**		

Table 23 Top countries by SBM net imports 2010/2011

COUNTRY	NET IMPORTS (Tons)
France	3,442,340
Indonesia	2,903,716
Viet Nam	2,763,446
Thailand	2,506,844
Japan	2,195,202
Germany	2,147,029
Italy	2,075,522
United Kingdom	2,036,403
Spain	1,950,575
Poland	1,870,718
Iran	1,689,843
Republic of Korea	1,584,497
Philippines	1,513,725
Denmark	1,462,649
Venezuela	1,080,536
Algeria	1,036,072
Malaysia	1,014,715
Mexico	1,002,680

Table 24 Top 25 countries by soybeans market size 2010/2011

COUNTRY	DEMAND (10-11) Tons	%OF WORLD DEMAND	% GROWTH (97-11)
China, mainland	65,828,011	25.5%	9.7%
United States of America	50,586,760	19.6%	0.5%
Argentina	38,629,874	15.0%	7.8%
Brazil	37,835,708	14.7%	4.1%
India	12,341,202	4.8%	4.4%
Mexico	3,744,506	1.5%	0.5%
Japan	3,410,645	1.3%	-2.6%
Paraguay	3,277,636	1.3%	10.1%
Spain	3,207,779	1.2%	0.2%
Germany	3,047,056	1.2%	-1.5%
Indonesia	2,790,234	1.1%	3.1%
China, Taiwan Province of	2,681,077	1.0%	1.5%
Russian Federation	2,470,293	1.0%	18.8%
Netherlands	2,362,973	0.9%	-3.8%
Thailand	2,076,619	0.8%	5.0%
Italy	1,859,002	0.7%	-0.1%
Canada	1,853,904	0.7%	-1.0%
Bolivia (Plurinational State of)	1,821,276	0.7%	5.1%
Egypt	1,817,921	0.7%	19.1%
Turkey	1,682,810	0.7%	12.7%
Ukraine	1,324,067	0.5%	31.6%
Republic of Korea	1,302,456	0.5%	-1.0%
Iran (Islamic Republic of)	898,161	0.3%	11.9%
United Kingdom	814,718	0.3%	-0.8%
Rest of the world	10,429,590	4%	
WORLD	**258,094,275**		**4.0%**

Table 25 Top 25 countries by soybeans production 2010/2011

	COUNTRY	PRODUCTION (10-11) Tons	%OF WORLD PRODUCTION	% GROWTH (97-11)
1	United States of America	87,398,692	33.2%	1.2%
2	Brazil	71,785,892	27.3%	6.7%
3	Argentina	50,778,068	19.3%	9.2%
4	China, mainland	14,784,000	5.6%	-0.1%
5	India	12,475,000	4.7%	4.4%
6	Paraguay	7,885,114	3.0%	7.8%
7	Canada	4,295,800	1.6%	3.3%
8	Ukraine	1,972,300	0.8%	35.9%
9	Uruguay	1,915,000	0.7%	40.7%
10	Bolivia (Plurinational State of)	1,777,043	0.7%	3.8%
11	Russian Federation	1,489,190	0.6%	12.4%
12	Indonesia	875,435	0.3%	-2.9%
13	South Africa	638,000	0.2%	10.4%
14	Italy	558,569	0.2%	-5.3%
	Rest of the world	4,336,700	1.6%	
	WORLD	**262,964,803**		**4.0%**

Table 26 Top countries by Soybeans exports 2010/2011

COUNTRY	EXPORTS (Tons)	% GROWTH (97-11)	%OF WORLD
United States of America	38,338,323	1.8%	41%
Brazil	31,029,688	9.6%	33%
Argentina	12,218,025	22.9%	13%
Paraguay	4,486,155	6.6%	5%
Canada	2,713,769	11.8%	3%
Uruguay	1,896,800	70.4%	2%
Netherlands	1,699,558	2.8%	2%
Ukraine	650,272	55.8%	1%
Slovenia	304,374	122.9%	0%
China, mainland	234,016	1.7%	0%
Rest of the world	1,040,235		1%
WORLD	**94,611,213**		

Table 27 Top countries by Soybeans net exports 2010/2011

COUNTRY	NET EXPORTS (Tons)
United States of America	37,911,933
Brazil	30,950,185
Argentina	12,210,495
Paraguay	4,469,979
Canada	2,441,896
Uruguay	1,874,892
Ukraine	648,233

Table 28 Top countries by Soybeans imports 2010/2011

COUNTRY	IMPORTS (Tons)	% GROWTH (97-11)	%OF WORLD
China, mainland	53,628,026	21.3%	57%
Mexico	3,558,162	-0.1%	4%
Netherlands	3,355,477	-2.9%	4%
Germany	3,289,536	0.3%	4%
Spain	3,153,006	1.0%	3%
Japan	3,143,256	-3.8%	3%
China, Taiwan Province of	2,447,519	-1.1%	3%
Indonesia	1,917,574	8.5%	2%
Thailand	1,909,428	5.7%	2%
Egypt	1,732,434	18.2%	2%
Turkey	1,588,877	12.1%	2%
Italy	1,396,240	3.3%	1%
Republic of Korea	1,187,594	-2.1%	1%
Russian Federation	983,982	66.6%	1%
Rest of the world	10,528,615		11%
WORLD	**93,819,722**		

Table 29 Top countries by Soybeans net imports 2010/2011

COUNTRY	NET IMPORTS (Tons)
China, mainland	53,394,010
Mexico	3,558,056
Germany	3,245,954
Spain	3,147,023
Japan	3,139,495
China, Taiwan Province of	2,440,382
Indonesia	1,914,799
Thailand	1,900,016
Egypt	1,732,358
Netherlands	1,655,919
Turkey	1,588,410
Italy	1,300,433
Republic of Korea	1,185,087

Table 30 Poultry leading demand cluster

	Country	Poultry demand Kg/person-year	Pork demand Kg/person-year	GDP USD 2011 PPP
1	Afghanistan	2.5	0.0	1,666
2	Albania	13.9	9.7	9,728
3	Algeria	7.4	0.0	12,550
4	Angola	14.3	7.3	7,071
5	Antigua and Barbuda	80.5	22.3	20,278
6	Armenia	14.3	8.4	6,660
7	Australia	42.6	22.7	41,518
8	Azerbaijan	9.3	0.4	15,852
9	Bahamas	71.4	44.5	22,870
10	Bangladesh	1.4	0.0	2,524
11	Barbados	54.3	18.1	15,355
12	Belize	45.0	16.0	8,193
13	Benin	10.7	0.8	1,640
14	Bermuda	68.4	24.3	55,690
15	Bolivia	37.1	8.4	5,370
16	Bosnia and Herzegovina	12.9	8.4	9,196
17	Botswana	5.3	0.6	13,700
18	Brazil	39.2	12.5	14,172
19	Brunei Darussalam	59.7	6.6	71,314
20	Burkina Faso	2.4	2.0	1,427
21	Cameroon	3.3	2.0	2,590
22	Canada	36.2	28.7	41,023
23	Chad	0.4	0.1	1,924
24	Chile	34.5	22.6	19,686
25	China, Hong Kong SAR	79.3	76.8	49,103
26	Colombia	24.0	4.8	11,055
27	Congo	14.8	1.9	5,551
28	Costa Rica	21.7	9.9	12,508
29	Côte d'Ivoire	1.8	1.1	2,799
30	Denmark	24.5	20.6	42,646
31	Djibouti	1.2	0.5	2,716
32	Dominica	56.0	16.8	10,354
33	Dominican Republic	34.3	11.2	11,175
34	Ecuador	22.4	13.3	9,596
35	Egypt	12.0	0.0	10,625
36	El Salvador	17.8	2.7	7,295
37	Ethiopia	0.6	0.0	1,126
38	Fiji	22.5	4.7	7,163
39	Gabon	40.1	6.6	17,107
40	Gambia	3.8	0.5	1,606
41	Georgia	12.2	6.5	6,130
42	Ghana	7.1	1.0	3,255
43	Grenada	63.8	11.4	11,199
44	Guatemala	17.7	5.2	6,903
45	Guinea	1.5	0.3	1,193
46	Guyana	34.2	2.2	5,675
47	Haiti	6.8	4.4	1,549
48	Honduras	22.3	5.8	4,308
49	Iceland	23.7	19.7	39,554
50	India	1.8	0.3	4,761
51	Indonesia	6.7	2.9	8,232
52	Iran	25.6	0.0	15,837
53	Iraq	12.3	0.0	12,789
54	Israel	73.7	2.5	29,769
55	Jamaica	55.2	3.8	8,428
56	Jordan	33.6	0.0	11,274
57	Kenya	0.6	0.3	2,544
58	Kiribati	15.2	11.4	1,740
59	Kuwait	68.9	0.0	81,756
60	Kyrgyzstan	15.9	5.3	2,855
61	Lebanon	21.4	2.2	16,347
62	Lesotho	5.0	1.8	2,249
63	Liberia	6.8	3.4	709
64	Libya	19.9	0.0	20,810
65	Madagascar	3.4	2.6	1,381
66	Malaysia	45.1	8.7	20,747
67	Maldives	20.4	1.3	10,920
68	Mali	3.0	0.2	1,661
69	Mauritania	3.8	0.0	2,692
70	Mauritius	39.1	3.0	15,491
71	Mexico	29.3	14.1	15,673
72	Mongolia	1.9	0.1	6,985
73	Morocco	19.8	0.0	6,582
74	Namibia	8.4	3.4	8,577
75	Nepal	1.0	0.6	2,021
76	New Zealand	33.6	20.6	31,456
77	Nicaragua	18.3	2.9	4,130
78	Niger	1.0	0.1	835
79	Nigeria	2.0	1.5	5,165
80	Pakistan	4.2	0.0	4,240
81	Panama	38.1	12.0	15,587
82	Peru	36.4	4.1	10,172
83	Russian Federation	22.8	22.6	22,152
84	Saint Kitts and Nevis	77.2	10.2	20,531
85	Saint Lucia	69.2	17.1	10,525
86	Saint Vincent Grenadines	70.4	14.9	9,900
87	Samoa	58.1	21.1	5,535
88	Sao Tome and Principe	10.7	3.9	2,772
89	Saudi Arabia	46.7	0.0	47,705
90	Senegal	3.9	0.9	2,172
91	Sierra Leone	3.9	0.7	1,372
92	South Africa	34.0	4.4	11,780
93	Sri Lanka	4.9	0.0	7,842
94	Suriname	55.0	8.8	14,633
95	Swaziland	5.2	1.3	6,439
96	Tajikistan	3.3	1.2	2,161
97	The FYR of Macedonia	17.2	9.3	11,173
98	Togo	6.2	1.5	1,260
99	Trinidad and Tobago	62.6	8.1	29,032
100	Tunisia	14.4	0.0	10,322
101	Turkey	18.6	0.0	17,378
102	Turkmenistan	4.1	0.6	10,696
103	Ukraine	22.6	16.8	8,076
104	United Arab Emirates	38.5	1.5	56,878
105	United Kingdom	32.3	26.2	36,474
106	Tanzania	1.2	0.3	1,571
107	United States of America	51.0	28.2	49,590
108	Uruguay	22.5	12.1	17,070
109	Uzbekistan	1.3	0.9	4,299
110	Venezuela	44.6	7.1	16,748
111	Yemen	10.4	0.0	4,147
112	Zambia	3.2	1.7	3,504
113	Zimbabwe	6.4	2.7	1,555

Table 31 Pork leading demand cluster

	Country	Pork demand Kg/person-year	Poultry demand Kg/person-year	GDP USD 2011 PPP
1	Austria	68.3	20.1	43,623
2	Belarus	40.7	24.9	16,153
3	Belgium	35.6	22.3	40,902
4	Bulgaria	27.7	20.1	15,082
5	Cabo Verde	23.7	18.8	6,105
6	Cambodia	7.4	2.0	2,580
7	Central African Republic	4.1	1.4	907
8	China, Macao SAR	60.1	36.3	107,955
9	China, mainland	35.7	12.2	9,636
10	Croatia	42.3	8.5	20,280
11	Cuba	19.5	16.6	18,544
12	Cyprus	50.5	32.5	30,589
13	Czech Republic	45.6	23.5	28,210
14	Estonia	45.9	20.1	22,646
15	Finland	35.6	19.0	39,867
16	France	34.0	24.2	37,022
17	Germany	53.8	18.8	41,652
18	Greece	31.6	15.6	28,215
19	Guinea-Bissau	9.0	2.0	1,412
20	Hungary	40.9	26.8	22,504
21	Ireland	31.8	22.9	44,647
22	Italy	41.0	18.1	35,843
23	Japan	20.7	18.9	34,443
24	Kazakhstan	15.7	14.5	20,187
25	Lao People's DR	8.9	3.8	4,017
26	Latvia	40.2	21.2	18,857
27	Lithuania	47.5	23.5	21,455
28	Luxembourg	44.1	21.9	90,138
29	Malawi	2.5	1.4	742
30	Malta	37.5	30.0	28,042
31	Montenegro	51.2	14.1	13,855
32	Mozambique	4.1	1.7	955
33	Netherlands	33.9	17.8	46,036
34	Norway	26.5	17.4	61,885
35	Paraguay	25.2	6.2	7,097
36	Philippines	18.3	10.8	5,667
37	Poland	53.5	22.6	21,705
38	Portugal	43.3	30.2	26,816
39	Republic of Korea	31.0	15.8	30,884
40	Republic of Moldova	18.4	15.7	4,045
41	Romania	29.8	16.0	17,125
42	Rwanda	0.7	0.2	1,293
43	Serbia	28.5	9.9	12,436
44	Slovakia	35.1	16.5	25,240
45	Slovenia	38.3	24.7	28,658
46	Solomon Islands	4.8	4.2	1,861
47	Spain	49.1	26.2	32,765
48	Sweden	37.7	16.8	43,468
49	Switzerland	33.7	16.1	54,032
50	Thailand	12.8	12.6	12,810
51	Timor-Leste	9.7	4.8	1,858
52	Uganda	3.3	1.8	1,314
53	Vanuatu	15.3	11.8	2,932
54	Viet Nam	34.2	13.6	4,602

Table 32 Poultry demand sourcing profiles

Cluster ID	Country	Ratio 10/11	Ratio 97/98	Ratio evolution
1	Belgium-Luxembourg	2.0	1.8	0.7%
1	Brazil	1.5	1.1	2.1%
1	Hungary	1.5	1.5	-0.1%
1	Netherlands	3.0	2.3	2.0%
1	Poland	1.5	1.0	3.0%
1	Thailand	1.6	1.3	1.5%
2	Afghanistan	0.4	1.0	-6.8%
2	Angola	0.1	0.2	-6.9%
2	Antigua and Barbuda	0.1	0.1	-0.6%
2	Armenia	0.1	0.2	-3.1%
2	Bahamas	0.3	0.6	-6.1%
2	Benin	0.2	0.4	-3.2%
2	Bermuda	0.0	0.0	-3.6%
2	China, Macao SAR	0.2	0.5	-6.7%
2	Dominica	0.1	0.1	-1.8%
2	French Polynesia	0.0	0.1	-2.6%
2	Georgia	0.2	0.4	-3.3%
2	Ghana	0.2	0.6	-7.1%
2	Grenada	0.1	0.1	-0.3%
2	Guinea	0.4	0.9	-5.2%
2	Haiti	0.1	0.3	-5.2%
2	Kuwait	0.2	0.4	-5.3%
2	Lesotho	0.2	0.3	-4.2%
2	Liberia	0.4	0.7	-3.8%
2	Malta	0.3	0.9	-6.2%
2	Mongolia	0.1	0.1	-4.5%
2	Netherlands Antilles	0.0	0.0	-3.4%
2	New Caledonia	0.1	0.1	-0.8%
2	Saint Kitts and Nevis	0.0	0.1	-2.5%
2	St Vincent and the Grenadines	0.1	0.1	-1.1%
2	Sao Tome and Principe	0.4	1.0	-6.4%
2	Timor-Leste	0.1	0.2	-3.8%
2	United Arab Emirates	0.1	0.2	-4.0%
2	Vanuatu	0.3	0.5	-3.4%
2	Viet Nam	0.5	1.0	-5.3%
4	Albania	0.4	0.5	-1.2%
4	Botswana	0.6	0.9	-3.0%
4	Bulgaria	0.7	0.9	-2.0%
4	Croatia	0.9	1.1	-1.9%
4	Cyprus	0.8	1.0	-1.9%
4	Czech Republic	0.7	0.9	-1.7%
4	Greece	0.7	0.8	-0.2%
4	Guatemala	0.7	0.9	-1.6%
4	Guinea-Bissau	0.6	0.9	-3.5%
4	Jamaica	0.7	0.6	0.8%
4	Japan	0.6	0.7	-0.9%
4	Kazakhstan	0.4	0.4	0.1%
4	Latvia	0.5	0.4	1.9%
4	Mexico	0.8	0.8	-0.4%
4	Mozambique	0.7	1.0	-1.8%
4	Republic of Moldova	0.7	1.0	-2.2%
4	Saudi Arabia	0.4	0.7	-2.7%
4	Sierra Leone	0.6	1.0	-3.0%
4	Slovakia	0.7	0.9	-1.4%
4	Suriname	0.4	0.3	1.7%
4	Sweden	0.7	1.1	-2.7%
4	Switzerland	0.6	0.5	0.8%
4	Togo	0.7	0.7	0.6%
4	Trinidad and Tobago	0.8	0.9	-1.1%
4	United Kingdom	0.8	0.9	-1.4%
4	Yemen	0.6	0.7	-0.8%
4	Zimbabwe	0.7	1.0	-2.3%
5	Azerbaijan	0.8	0.3	6.9%
5	Bosnia and Herzegovina	0.8	0.2	11.1%
5	Estonia	0.6	0.2	7.5%
5	Kiribati	0.5	0.3	3.5%
5	Namibia	0.6	0.2	8.6%
5	Russian Federation	0.8	0.4	5.3%
5	Saint Lucia	0.1	0.1	3.1%
5	Swaziland	0.9	0.5	4.7%
5	Uzbekistan	0.8	0.4	4.6%

Table 32 Poultry demand sourcing profiles (continued)

Cluster ID	Country	Ratio 10/11	Ratio 97/98	Ratio evolution	Cluster ID	Country	Ratio 10/11	Ratio 97/98	Ratio evolution
6	Algeria	0.99	1.00	0.0%	6	Lao People's DR	1.00	1.00	0.0%
6	Argentina	1.18	0.96	1.5%	6	Lebanon	0.93	0.98	-0.4%
6	Australia	1.03	1.03	0.0%	6	Libya	1.00	1.00	0.0%
6	Austria	0.80	0.80	0.0%	6	Lithuania	1.10	0.72	3.1%
6	Bangladesh	1.00	1.00	0.0%	6	Madagascar	0.99	1.00	0.0%
6	Barbados	0.95	0.86	0.7%	6	Malawi	1.00	0.96	0.3%
6	Belarus	1.18	1.09	0.6%	6	Malaysia	0.99	0.99	-0.1%
6	Belize	0.99	0.99	0.0%	6	Mali	0.97	1.00	-0.2%
6	Bolivia	1.00	1.02	-0.1%	6	Mauritius	0.97	0.97	0.0%
6	Brunei Darussalam	0.91	0.74	1.5%	6	Morocco	1.00	0.99	0.1%
6	Burkina Faso	1.00	1.00	0.0%	6	Myanmar	1.00	1.00	0.0%
6	Cambodia	0.99	1.00	-0.1%	6	Nepal	0.99	1.00	-0.1%
6	Cameroon	1.00	0.86	1.0%	6	New Zealand	1.03	1.02	0.1%
6	Canada	0.98	0.97	0.1%	6	Nicaragua	0.97	0.96	0.1%
6	Central African Republic	0.96	1.00	-0.3%	6	Niger	0.98	1.00	-0.1%
6	Chad	0.99	1.00	-0.1%	6	Nigeria	0.93	1.00	-0.5%
6	Chile	1.05	1.05	0.0%	6	Norway	0.99	1.00	0.0%
6	China, mainland	1.00	1.02	-0.1%	6	Pakistan	1.00	1.00	0.0%
6	China, Taiwan Province of	0.86	1.00	-1.1%	6	Panama	0.93	0.99	-0.5%
6	Colombia	0.96	0.95	0.0%	6	Paraguay	0.99	0.99	-0.1%
6	Costa Rica	1.00	1.03	-0.1%	6	Peru	0.98	0.98	0.0%
6	Côte d'Ivoire	0.97	0.92	0.4%	6	Philippines	0.90	0.99	-0.7%
6	People's Republic of Korea	1.00	1.00	0.0%	6	Portugal	0.89	0.97	-0.7%
6	Denmark	1.40	1.95	-2.3%	6	Republic of Korea	0.87	0.93	-0.5%
6	Dominican Republic	0.95	0.89	0.5%	6	Romania	0.97	0.89	0.6%
6	Ecuador	1.00	0.99	0.0%	6	Rwanda	1.00	1.00	0.0%
6	Egypt	0.92	1.00	-0.6%	6	Senegal	0.99	1.00	0.0%
6	El Salvador	0.96	1.00	-0.3%	6	Slovenia	1.16	1.16	0.0%
6	Ethiopia	1.00	1.00	0.0%	6	Somalia	1.00	1.00	0.0%
6	Fiji	0.93	0.91	0.1%	6	South Africa	0.85	0.90	-0.5%
6	Finland	0.97	0.97	0.0%	6	Spain	0.98	0.95	0.2%
6	France	1.13	1.45	-1.8%	6	Sri Lanka	1.00	0.99	0.1%
6	Germany	0.90	0.65	2.3%	6	Sudan (former)	0.94	1.00	-0.5%
6	Guyana	0.93	0.67	2.4%	6	Syrian Arab Republic	0.98	1.00	-0.1%
6	Honduras	0.91	0.94	-0.2%	6	Tunisia	1.01	1.00	0.0%
6	Iceland	0.93	0.96	-0.2%	6	Turkey	1.14	1.02	0.8%
6	India	1.00	1.00	0.0%	6	Turkmenistan	0.94	0.89	0.4%
6	Indonesia	1.00	1.00	0.0%	6	Uganda	1.00	0.99	0.0%
6	Iran (Islamic Republic of)	0.99	0.97	0.1%	6	Ukraine	0.94	0.78	1.3%
6	Ireland	1.14	1.16	-0.1%	6	Republic of Tanzania	0.99	1.00	-0.1%
6	Israel	1.02	1.02	0.0%	6	USA	1.23	1.20	0.2%
6	Italy	1.09	1.07	0.1%	6	Uruguay	1.03	1.03	0.0%
6	Jordan	0.85	0.95	-0.8%	6	Venezuela	0.86	1.01	-1.1%
6	Kenya	1.00	1.00	0.0%	6	Zambia	0.98	1.00	-0.1%

Table 33 Pork demand-sourcing profiles

Cluster ID	Country	Ratio 10/11	Ratio 97/98	Ratio evolution
1	Belgium-Luxembourg	2.7	3.0	-0.6%
1	Canada	2.0	1.4	2.6%
1	Ireland	1.6	1.7	-0.6%
1	Netherlands	2.3	2.0	1.2%
1	Spain	1.5	1.1	2.4%
2	Albania	0.4	0.5	-1.3%
2	Azerbaijan	0.2	0.2	0.0%
2	Bahamas	0.0	0.0	0.5%
2	Brunei Darussalam	0.0	0.0	0.5%
2	Congo	0.2	0.3	-0.5%
2	Dominica	0.4	0.5	-1.8%
2	French Polynesia	0.3	0.3	-0.6%
2	Gabon	0.3	0.4	-2.2%
2	Japan	0.5	0.6	-1.7%
2	Mauritius	0.2	0.3	-2.3%
2	Netherlands Antilles	0.0	0.0	-1.2%
2	New Caledonia	0.3	0.3	-1.0%
2	Trinidad and Tobago	0.3	0.4	-2.5%
3	Argentina	0.8	0.7	1.0%
3	Austria	1.2	1.1	0.7%
3	Belarus	1.1	1.0	0.1%
3	Bolivia (Plurinational State of)	1.0	1.0	0.0%
3	Brazil	1.3	1.0	1.6%
3	Burkina Faso	1.0	1.0	0.0%
3	Cambodia	1.0	1.0	0.0%
3	Cameroon	0.9	0.9	0.1%
3	Central African Republic	1.0	1.0	0.0%
3	Chad	0.9	0.8	0.5%
3	Chile	1.3	1.1	1.5%
3	China, mainland	1.0	1.0	-0.1%
3	China, Taiwan Province of	0.9	1.0	-0.6%
3	Colombia	0.9	0.9	0.0%
3	Costa Rica	1.1	1.0	0.1%
3	Cyprus	1.0	1.0	-0.1%
3	People's Republic of Korea	1.0	1.0	-0.1%
3	Ecuador	1.0	1.0	-0.3%
3	Ethiopia	1.0	1.0	-0.2%
3	Fiji	1.0	1.0	0.1%
3	Finland	1.1	1.1	0.0%
3	France	1.0	1.1	-0.2%
3	Germany	1.2	0.8	2.8%
3	Guinea-Bissau	1.0	1.0	0.0%
3	Hungary	1.1	1.2	-0.8%
3	Iceland	1.0	1.0	-0.3%
3	India	1.0	1.0	0.0%
3	Indonesia	1.0	1.0	0.0%
3	Israel	1.0	1.0	-0.1%
3	Kenya	1.2	1.1	0.6%
3	Lao People's DR	1.0	1.0	0.0%
3	Lesotho	1.0	1.0	0.0%
3	Madagascar	1.0	1.0	0.0%
3	Malawi	1.0	1.0	0.0%
3	Malaysia	0.9	1.0	-0.4%
3	Mali	1.0	1.0	-0.1%
3	Mozambique	1.0	1.0	-0.1%
3	Myanmar	1.0	1.0	0.0%
3	Nepal	1.0	1.0	0.1%
3	Niger	1.0	1.0	-0.1%
3	Nigeria	1.0	1.0	0.3%
3	Norway	1.0	1.0	-0.1%
3	Paraguay	1.0	1.0	-0.1%
3	Peru	1.0	1.0	-0.2%
3	Philippines	0.9	1.0	-0.3%
3	Rwanda	1.0	1.0	-0.1%
3	Senegal	1.0	1.0	0.0%
3	Solomon Islands	0.9	1.0	-0.3%
3	Switzerland	0.9	0.9	0.2%
3	Thailand	1.0	1.0	0.1%
3	Timor-Leste	0.9	0.9	0.1%
3	Togo	1.0	1.0	0.5%
3	Uganda	1.0	1.0	0.0%
3	United States of America	1.2	1.0	0.9%
3	Uzbekistan	0.9	0.9	0.0%
3	Vanuatu	0.9	1.0	0.0%
3	Viet Nam	1.0	1.1	-0.4%
3	Zambia	1.0	1.0	0.2%

Table 33 Pork demand sourcing profiles (continued)

Cluster ID	Country	Ratio 10/11	Ratio 97/98	Ratio evolution
4	Angola	0.5	0.7	-2.6%
4	Armenia	0.4	0.7	-5.1%
4	Australia	0.7	1.0	-2.9%
4	Barbados	0.6	0.9	-3.2%
4	Belize	0.2	0.4	-3.3%
4	Benin	0.6	1.0	-3.4%
4	Czech Republic	0.6	1.0	-3.7%
4	El Salvador	0.5	0.8	-3.1%
4	Greece	0.3	0.4	-2.8%
4	Kyrgyzstan	0.6	1.0	-3.7%
4	Latvia	0.4	0.9	-4.8%
4	Lithuania	0.5	1.0	-4.8%
4	Malta	0.5	0.8	-3.6%
4	New Zealand	0.5	0.8	-2.8%
4	Nicaragua	0.5	0.9	-5.1%
4	Republic of Korea	0.6	1.0	-3.2%
4	Romania	0.7	1.0	-2.7%
4	St Vincent and the Grenadines	0.3	0.5	-4.2%
4	Sierra Leone	0.6	1.0	-4.0%
4	Slovenia	0.5	0.8	-3.1%
4	Somalia	0.7	1.0	-2.6%
4	Suriname	0.4	0.6	-2.3%
4	Tajikistan	0.3	0.6	-4.5%
4	United Kingdom	0.5	0.8	-3.4%
4	Uruguay	0.5	0.8	-3.5%
5	Bermuda	0.0	0.0	1.7%
5	Bosnia and Herzegovina	0.5	0.2	5.0%
5	Botswana	0.4	0.2	5.5%
5	Grenada	0.2	0.2	1.9%
5	Guyana	0.5	0.3	2.9%
5	Namibia	0.6	0.3	5.7%
5	Saint Lucia	0.5	0.3	2.4%
5	Swaziland	0.8	0.4	4.5%
5	The FYR of Macedonia	0.4	0.4	1.1%
6	Antigua and Barbuda	0.1	0.3	-6.4%
6	Bulgaria	0.4	1.0	-7.0%
6	China, Hong Kong SAR	0.2	0.5	-5.0%
6	China, Macao SAR	0.2	0.5	-5.8%
6	Côte d'Ivoire	0.3	0.9	-7.1%

Cluster ID	Country	Ratio 10/11	Ratio 97/98	Ratio evolution
6	Georgia	0.4	1.0	-5.9%
6	Honduras	0.2	0.8	-8.3%
6	Lebanon	0.1	0.2	-6.9%
6	Saint Kitts and Nevis	0.1	0.4	-8.5%
6	Sao Tome and Principe	0.2	0.3	-4.6%
6	Slovakia	0.4	0.9	-5.9%
6	Turkmenistan	0.1	0.6	-12.0%
7	Algeria	0.7	0.8	-1.2%
7	Cabo Verde	0.7	0.9	-1.3%
7	Croatia	0.7	0.8	-1.0%
7	Cuba	0.8	0.8	-0.3%
7	Dominican Republic	0.9	1.0	-0.9%
7	Egypt	0.6	0.5	0.3%
7	Estonia	0.8	0.9	-0.8%
7	Gambia	0.7	0.8	-1.2%
7	Ghana	0.7	0.7	0.1%
7	Guatemala	0.8	0.8	-0.4%
7	Guinea	0.9	0.9	-0.6%
7	Haiti	0.8	0.9	-1.0%
7	Italy	0.7	0.7	-0.1%
7	Jamaica	0.7	0.8	-0.6%
7	Kazakhstan	0.8	0.9	-0.8%
7	Kiribati	0.8	0.8	-0.3%
7	Liberia	0.7	0.8	-1.2%
7	Mexico	0.7	0.9	-1.8%
7	Mongolia	0.8	0.8	-0.2%
7	Morocco	0.7	0.9	-1.6%
7	Panama	0.7	0.8	-0.6%
7	Poland	0.9	1.1	-1.3%
7	Portugal	0.8	0.8	0.2%
7	Republic of Moldova	0.9	1.1	-1.5%
7	Russian Federation	0.7	0.7	-0.1%
7	Samoa	0.9	1.0	-0.6%
7	South Africa	0.9	1.0	-0.5%
7	Sweden	0.7	1.0	-2.2%
7	Tunisia	0.8	1.0	-1.7%
7	Ukraine	0.9	1.0	-1.0%
7	United Republic of Tanzania	0.9	1.0	-0.6%
7	Venezuela	0.8	1.0	-1.2%
7	Zimbabwe	0.9	1.1	-1.7%

Table 34 Demand sourcing profiles summary

Poultry average					
Cluster ID	**cluster size**	**cluster size %**	**Ratio 10/11**	**Ratio 97/98**	**Ratio evolution**
1	6	3%	1.8	1.5	1.6%
2	29	17%	0.2	0.4	-4.0%
3	13	8%	0.1	0.6	-10.6%
4	27	16%	0.7	0.8	-1.2%
5	9	5%	0.7	0.3	6.1%
6	88	51%	1.0	1.0	0.0%

Pork average					
Cluster ID	**cluster size**	**cluster size %**	**Ratio 10/11**	**Ratio 97/98**	**Ratio evolution**
1	5	3%	2.0	1.8	1.0%
2	13	8%	0.2	0.3	-1.1%
3	58	37%	1.0	1.0	0.1%
4	25	16%	0.5	0.8	-3.5%
5	9	6%	0.4	0.3	3.4%
6	12	8%	0.2	0.6	-7.0%
7	33	21%	0.8	0.9	-0.8%

Table 35 Soybeans clusters

Cluster ID	Country	Demand 10/11	Exports 10/11	Imports 10/11	Processing 10/11	Production 10/11
		Soybeans Tons 2010/2011				
1	Afghanistan	-	-	-	-	-
1	Bermuda	-	-	-	-	-
1	Central African Republic	-	-	-	-	-
1	Chad	-	-	-	-	-
1	Djibouti	-	-	-	-	-
1	Grenada	1	-	1	-	-
1	Guinea	-	-	-	-	-
1	Guinea-Bissau	-	-	-	-	-
1	Lesotho	-	-	-	-	-
1	Netherlands Antilles	-	-	-	-	-
1	Niger	1	-	1	-	-
1	Occupied Palestinian Territory	-	-	-	-	-
1	Sao Tome and Principe	-	-	-	-	-
1	Sierra Leone	-	-	-	-	-
1	Somalia	-	-	-	-	-
1	Turkmenistan	-	-	-	-	-
2	Albania	579	-	29	512	550
2	Bosnia and Herzegovina	45,184	136	37,942	39,750	7,378
2	China, mainland	68,178,010	234,016	53,628,026	51,333,000	14,784,000
2	Colombia	379,321	322	314,821	357,550	64,822
2	Czech Republic	42,386	1,939	27,308	36,300	17,017
2	People's Republic of Korea	376,000	-	26,000	256,960	350,000
2	Egypt	1,768,921	77	1,732,434	1,724,150	36,564
2	France	710,263	29,237	609,865	557,800	129,635
2	Gabon	4,852	-	1,687	4,521	3,165
2	Greece	275,293	57	271,199	273,657	4,150
2	Guatemala	45,695	143	8,838	39,264	37,000
2	Honduras	4,982	10	2,920	4,779	2,072
2	Indonesia	2,790,234	2,775	1,917,574	2,305,245	875,435
2	Iran (Islamic Republic of)	1,012,139	1,451	847,241	862,500	166,349
2	Iraq	4,814	-	4,762	4,809	52
2	Italy	1,859,002	95,807	1,396,240	1,579,650	558,569
2	Japan	3,360,145	3,761	3,143,256	2,270,450	220,650
2	Mexico	3,744,506	106	3,558,162	2,260,000	186,450
2	Morocco	119,687	9	118,695	116,034	1,000
2	Nepal	72,953	-	47,774	67,424	25,180
2	Republic of Korea	1,302,456	2,508	1,187,594	907,850	117,370
2	Russian Federation	2,470,293	2,879	983,982	1,575,750	1,489,190
2	Sri Lanka	6,470	45	835	5,476	5,680
2	Switzerland	27,243	224	24,279	25,750	3,188
2	Syrian Arab Republic	443,580	250	441,144	420,950	2,686
2	Thailand	2,076,619	9,413	1,909,428	1,430,550	176,604
2	Turkey	1,682,810	467	1,588,877	1,522,746	94,400
2	Venezuela	202,828	1	150,477	172,158	52,351
2	Zimbabwe	80,722	-	12,058	72,850	68,664
3	Algeria	106	-	106	-	-
3	Angola	80	-	80	-	-
3	Antigua and Barbuda	5	-	5	-	-
3	Armenia	5	-	5	-	-
3	Azerbaijan	12,130	-	12,125	-	5
3	Bahamas	31	-	31	-	-
3	Belarus	7,486	99	7,585	-	-
3	Botswana	3,597	1	3,598	-	-
3	Brunei Darussalam	745	2	747	-	-
3	Cabo Verde	4	-	4	-	-
3	China, Macao SAR	1,100	-	1,100	-	-
3	Congo	6	-	6	-	-
3	Cyprus	107	-	107	-	-
3	Dominica	2	-	2	-	-
3	Fiji	229	4	233	-	-
3	French Polynesia	210	-	210	-	-
3	Gambia	29	-	29	-	-
3	Ghana	316	10	326	-	-
3	Guyana	2,086	2	2,088	-	-
3	Iceland	39	-	39	-	-
3	Kiribati	38	-	38	-	-
3	Kyrgyzstan	2,683	-	2,591	-	92
3	Lithuania	1,023	9	1,031	-	-
3	Madagascar	313	1	272	-	42
3	Maldives	46	-	46	-	-
3	Malta	60	-	60	-	-
3	Mauritania	4	-	4	-	-
3	Mongolia	90	-	90	-	-
3	Montenegro	772	-	772	-	-
3	Mozambique	1,184	-	1,184	-	-
3	Namibia	5	-	5	-	-
3	New Caledonia	138	-	138	-	-
3	New Zealand	1,729	18	1,747	-	-
3	Panama	6,553	1	6,463	-	91
3	Peru	92,818	302	90,356	3,430	2,764
3	Saint Kitts and Nevis	2	-	2	-	-
3	Saint Lucia	3	-	3	-	-
3	St Vincent and the Grenadines	1,119	-	1,119	-	-
3	Samoa	71	-	71	-	-
3	Senegal	8,761	-	8,761	-	-
3	Solomon Islands	31	-	31	-	-
3	Sudan (former)	103	-	103	-	-
3	Suriname	179	-	163	-	16
3	Vanuatu	40	-	40	-	-
3	Viet Nam	818,789	32,150	568,370	85,094	282,569
3	Yemen	1,900	-	1,900	-	-

Table 35 Soybeans clusters (continued)

Cluster ID	Country	Demand 10/11	Exports 10/11	Imports 10/11	Processing 10/11	Production 10/11
		Soybeans Tons 2010/2011				
4	China, Hong Kong SAR	22,320	19,732	42,052	-	-
4	Estonia	846	279	1,125	-	-
4	Mauritius	279	47	325	-	-
4	Slovenia	4,393	304,374	308,476	-	291
4	Swaziland	333	190	523	-	-
5	Barbados	24,240	-	24,240	24,211	-
5	Belgium	355,984	224,330	580,314	53,410	-
5	Bulgaria	11,451	2,446	12,733	8,443	1,164
5	Chile	87,283	11,780	99,062	86,814	-
5	China, Taiwan Province of	2,440,536	7,138	2,447,519	2,286,000	155
5	Costa Rica	226,482	52	226,534	234,700	-
5	Cuba	117,566	-	117,566	97,555	-
5	Denmark	92,426	140	92,566	67,783	-
5	Dominican Republic	4,421	-	4,421	4,421	-
5	Finland	8,552	3	8,555	8,293	-
5	Germany	3,247,454	43,582	3,289,536	2,994,600	1,500
5	Ireland	19,195	1,328	20,523	4,400	-
5	Israel	454,583	3	454,586	382,900	-
5	Jamaica	340	28	368	327	-
5	Kuwait	74	4	78	74	-
5	Latvia	13,237	13,094	26,330	13,450	-
5	Lebanon	1,761	7	1,768	1,418	-
5	Libya	98	-	98	71	-
5	Luxembourg	629	133	762	140	-
5	Malaysia	611,495	26,937	638,432	610,395	-
5	Netherlands	1,655,919	1,699,558	3,355,477	2,362,000	-
5	Norway	415,045	2	415,047	404,870	-
5	Philippines	79,933	2,131	81,316	71,818	748
5	Poland	17,108	1,681	18,499	15,943	290
5	Portugal	735,304	22,084	757,388	689,000	-
5	Saudi Arabia	492,712	71	492,783	433,262	-
5	Spain	3,148,779	5,983	3,153,006	3,191,000	1,756
5	Sweden	22,792	345	23,137	21,689	-
5	Trinidad and Tobago	6,221	8	6,229	5,973	-
5	Tunisia	442,212	16	442,228	394,000	-
5	United Arab Emirates	2,448	483	2,931	6,000	-
5	United Kingdom	814,718	6,990	821,708	686,050	-
5	Uzbekistan	4,383	-	4,383	14,700	-
6	Austria	155,417	46,904	100,359	21,500	101,961
6	Bangladesh	158,894	-	91,192	-	67,703
6	Belize	693	-	35	-	658
6	Cameroon	12,817	-	6	-	12,811

Cluster ID	Country	Demand 10/11	Exports 10/11	Imports 10/11	Processing 10/11	Production 10/11
		Soybeans Tons 2010/2011				
6	Côte d'Ivoire	986	-	107	-	879
6	El Salvador	4,756	17	218	-	4,556
6	Ethiopia	26,180	681	1,008	-	25,852
6	Georgia	1,441	-	10	-	1,431
6	Kenya	13,626	90	10,778	-	2,938
6	Liberia	3,100	-	50	-	3,050
6	Malawi	67,640	7,856	985	-	74,511
6	Mali	1,929	-	44	-	1,886
6	Pakistan	245	62	236	-	70
6	Rwanda	48,193	4	939	-	47,258
6	Tajikistan	18	-	-	-	18
6	The FYR of Macedonia	1,238	-	468	-	770
6	Timor-Leste	958	-	-	-	958
6	United Republic of Tanzania	3,994	879	2,072	-	2,800
7	Argentina	38,567,574	12,218,025	7,531	37,082,250	50,778,068
7	Australia	38,431	15,231	8,987	39,285	44,675
7	Benin	10,654	347	1	10,653	11,000
7	Bolivia	1,746,276	39,257	8,490	1,672,500	1,777,043
7	Brazil	40,835,708	31,029,688	79,504	35,659,750	71,785,892
7	Burkina Faso	22,589	137	1	-	22,725
7	Canada	1,853,904	2,713,769	271,873	1,337,075	4,295,800
7	Croatia	121,851	46,216	17,642	98,900	150,426
7	Ecuador	70,806	59	365	64,629	70,500
7	Haiti	1	-	1	-	-
7	Hungary	74,487	36,078	20,367	58,050	90,198
7	India	12,441,201	34,378	579	11,119,500	12,475,000
7	Kazakhstan	119,685	5,503	1,693	29,250	123,495
7	Lao PD Republic	12,473	155	-	5,520	12,628
7	Myanmar	242,363	5,000	-	202,510	247,363
7	Nicaragua	4,339	218	39	4,213	4,518
7	Nigeria	413,462	11,000	32	20,000	424,430
7	Paraguay	3,415,136	4,486,155	16,177	1,831,473	7,885,114
7	Republic of Moldova	59,859	44,081	9,255	44,050	94,684
7	Romania	116,526	54,829	25,067	32,867	146,288
7	Serbia	441,688	72,358	23,192	306,500	490,853
7	Slovakia	28,377	12,265	10,159	27,876	30,483
7	South Africa	557,620	82,677	2,296	234,074	638,000
7	Togo	1,335	362	147	1,950	1,550
7	Uganda	196,102	1,495	227	143,500	197,370
7	Ukraine	1,324,067	650,272	2,039	366,000	1,972,300
7	United States of America	49,486,760	38,338,323	426,391	45,850,000	87,398,692
7	Zambia	107,599	7,844	1,230	20,000	114,213

Table 36 Soybeans clusters summary

Soybeans. Average Tons by cluster 2010/2011								
Cluster ID	cluster size	cluster size %	Demand 10/11	Exports 10/11	Imports 10/11	Processing 10/11	Production 10/11	Archetype Associated
1	16	9%	0	0	0	0	0	No soybeans activity
2	58	33%	3,209,930	13,297	2,551,498	2,421,670	671,730	Import to Process (I2P) - (P2P)
3	46	26%	21,016	709	15,517	1,924	6,208	Import to supply (I2S)
4	5	3%	5,634	64,924	70,500	0	58	Import to Export (I2E)
5	33	19%	471,375	62,738	533,943	459,870	170	Import to Process (I2P)
6	18	10%	27,896	3,138	11,584	1,194	19,450	Produce to supply (P2S)
7	29	16%	5,256,528	3,100,446	32,185	4,700,858	8,324,790	Produce to process (P2P) - (P2E)

*Uruguay excluded

Table 37 SBM clusters

Cluster ID	Country	SBM Tons 2010/2011 Demand 10/11	Exports 10/11	Imports 10/11	Production 10/11
1	Afghanistan	-	-	-	-
1	Antigua and Barbuda	-	-	-	-
1	Bahamas	-	-	-	-
1	Bermuda	-	-	-	-
1	Central African Republic	-	-	-	-
1	Chad	-	-	-	-
1	China, Macao SAR	-	-	-	-
1	Djibouti	-	-	-	-
1	Dominica	-	-	-	-
1	Ghana	-	-	-	-
1	Guinea-Bissau	-	-	-	-
1	Kiribati	-	-	-	-
1	Lesotho	-	-	-	-
1	Maldives	-	-	-	-
1	Mauritania	-	-	-	-
1	Netherlands Antilles	-	-	-	-
1	Occupied Palestinian Territory	-	-	-	-
1	Saint Kitts and Nevis	-	-	-	-
1	Saint Lucia	-	-	-	-
1	Saint Vincent	-	-	-	-
1	Samoa	-	-	-	-
1	Sao Tome and Principe	-	-	-	-
1	Sierra Leone	-	-	-	-
1	Solomon Islands	-	-	-	-
1	Somalia	-	-	-	-
1	Timor-Leste	-	-	-	-
1	Turkmenistan	-	-	-	-
1	Vanuatu	-	-	-	-
2	Albania	18,261	6	17,872	394
2	Australia	546,216	102	514,890	31,428
2	Bosnia and Herzegovina	79,026	18,080	66,101	31,005
2	Cambodia	68,293	-	17,668	50,625
2	Canada	1,985,799	113,584	1,042,783	1,056,600
2	Chile	581,349	-	511,899	69,451
2	China, Taiwan Province of	1,864,940	6,304	65,304	1,805,940
2	Colombia	1,213,686	41	963,442	250,285
2	Costa Rica	205,718	1,356	21,724	185,350
2	Croatia	223,019	2,530	145,699	79,850
2	Cuba	354,895	-	286,607	68,289
2	Czech Republic	482,242	4,076	457,668	28,650
2	Democratic PR of Korea	232,106	-	31,677	200,429
2	Dominican Republic	398,699	-	395,162	3,537
2	Ecuador	613,471	112	565,111	48,472
2	Egypt	2,101,247	423	722,350	1,379,320
2	Finland	162,738	28	156,132	6,634
2	France	3,858,790	126,694	3,569,034	416,450
2	Gabon	4,828	-	1,211	3,617
2	Germany	4,535,179	1,289,362	3,436,391	2,388,150
2	Greece	519,176	36,363	342,087	213,453
2	Guatemala	316,275	8	286,834	29,448
2	Honduras	167,752	250	164,179	3,823
2	Hungary	630,998	20,467	605,215	46,250
2	Indonesia	4,747,911	-	2,903,716	1,844,196
2	Iran	2,371,218	782	1,690,625	681,375
2	Iraq	9,172	-	5,324	3,848
2	Israel	396,051	1,823	91,554	306,320
2	Italy	3,326,972	168,657	2,244,179	1,251,450
2	Jamaica	69,622	-	69,360	262
2	Japan	3,921,193	83	2,195,284	1,725,991
2	Kuwait	69,281	-	69,222	59
2	Libya	219,257	-	219,200	57
2	Malaysia	1,496,926	26,941	1,041,656	482,212
2	Mexico	2,810,680	6,987	1,009,666	1,808,000
2	Morocco	576,268	-	483,441	92,827
2	Nepal	119,277	2,839	69,525	52,591
2	Nicaragua	67,012	342	63,984	3,371
2	Nigeria	40,449	2	24,451	16,000
2	Peru	997,676	-	994,932	2,744
2	Philippines	1,571,179	-	1,513,725	57,454
2	Portugal	719,341	54,595	225,635	548,300
2	Republic of Korea	2,256,697	65,805	1,650,301	672,200
2	Russian Federation	1,544,008	19,860	475,546	1,088,322
2	Saudi Arabia	878,889	-	532,280	346,610
2	Slovakia	133,660	1,999	114,195	21,464
2	South Africa	1,128,434	10,182	951,357	187,259
2	Spain	4,471,465	293,264	2,243,839	2,520,890
2	Sri Lanka	140,358	1	137,074	3,285
2	Sweden	277,340	504	260,493	17,351
2	Switzerland	307,407	32	286,939	20,500
2	Syrian Arab Republic	805,497	42,223	519,370	328,350
2	Thailand	3,622,344	262	2,507,106	1,115,500
2	Trinidad and Tobago	30,755	804	27,378	4,181
2	Tunisia	359,378	7,355	57,432	309,300
2	Turkey	1,684,761	8,442	475,007	1,218,197
2	Ukraine	321,637	1,986	45,462	278,160
2	United Kingdom	2,545,653	62,952	2,099,355	509,250
2	Uruguay	37,224	-	36,950	274
2	Venezuela	1,213,097	-	1,080,536	132,562
2	Viet Nam	2,831,521	9,587	2,773,033	68,075
2	Zimbabwe	98,024	315	41,489	56,850

Table 37 SBM clusters (continued)

SBM Tons 2010/2011					
Cluster ID	Country	Demand 10/11	Exports 10/11	Imports 10/11	Production 10/11
3	Algeria	1,036,072	-	1,036,072	-
3	Angola	593	-	593	-
3	Armenia	9,387	-	9,387	-
3	Austria	434,966	32,018	449,784	17,200
3	Azerbaijan	52,474	-	52,474	-
3	Bangladesh	385,095	-	385,095	-
3	Belarus	298,721	4,119	302,840	-
3	Belgium	815,172	585,054	1,357,875	42,350
3	Belize	9,884	-	9,884	-
3	Botswana	6,860	-	6,860	-
3	Brunei Darussalam	1,612	-	1,612	-
3	Bulgaria	104,031	14,194	111,640	6,586
3	Burkina Faso	55	-	55	-
3	Cabo Verde	1,339	-	1,339	-
3	Cameroon	28,857	1	28,858	-
3	China, Hong Kong SAR	11,365	360	11,725	-
3	Congo	2,908	-	2,908	-
3	Côte d'Ivoire	12,013	18	12,031	-
3	Cyprus	117,547	-	117,547	-
3	Denmark	1,515,149	207,826	1,670,474	52,500
3	El Salvador	151,053	-	151,053	-
3	Estonia	25,819	1,208	27,026	-
3	Fiji	7,902	-	7,902	-
3	French Polynesia	1,590	-	1,590	-
3	Georgia	5,391	7,220	12,611	-
3	Grenada	505	-	505	-
3	Guinea	457	-	457	-
3	Guyana	16,146	20	16,166	-
3	Haiti	41	-	41	-
3	Iceland	15,868	-	15,868	-
3	Ireland	385,477	9,660	391,661	3,476
3	Jordan	263,230	1,455	264,684	-
3	Kenya	42,154	-	42,154	-
3	Kyrgyzstan	642	-	642	-
3	Latvia	52,198	68,090	110,065	10,222
3	Lebanon	138,267	804	137,937	1,134
3	Liberia	1,500	-	1,500	-
3	Lithuania	115,115	35,822	150,937	-
3	Luxembourg	14,414	4,041	18,344	112
3	Madagascar	2,197	-	2,197	-
3	Malawi	1,210	918	2,128	-
3	Mali	121	-	121	-
3	Malta	17,154	-	17,154	-

SBM Tons 2010/2011					
Cluster ID	Country	Demand 10/11	Exports 10/11	Imports 10/11	Production 10/11
3	Mauritius	40,686	863	41,548	-
3	Mongolia	45	-	45	-
3	Montenegro	709	-	709	-
3	Mozambique	69,686	-	69,686	-
3	Namibia	2,587	-	2,587	-
3	Netherlands	2,466,135	4,919,379	5,586,564	1,798,950
3	New Caledonia	2,942	-	2,942	-
3	New Zealand	105,109	-	105,109	-
3	Niger	322	-	322	-
3	Pakistan	351,610	-	351,610	-
3	Panama	178,507	-	178,507	-
3	Poland	1,883,313	46,600	1,917,318	12,595
3	Romania	394,985	76,259	445,279	25,965
3	Rwanda	27	-	27	-
3	Senegal	6,863	24	6,886	-
3	Slovenia	8,641	830,035	838,676	-
3	Sudan (former)	5,741	-	5,741	-
3	Suriname	10,169	-	10,169	-
3	Swaziland	3,400	200	3,600	-
3	Tajikistan	2,713	-	2,713	-
3	The FYR of Macedonia	26,592	1	26,593	-
3	United Arab Emirates	130,272	32,939	158,471	4,740
3	Tanzania	431	-	431	-
3	Yemen	108,797	-	108,797	-
4	Argentina	2,966,730	25,892,185	285	28,858,630
4	Barbados	19,257	113	-	19,369
4	Benin	2,828	7,337	1,642	8,522
4	Bolivia	168,426	1,061,137	2	1,229,561
4	Brazil	13,680,255	14,011,885	32,140	27,660,000
4	China, mainland	41,587,894	711,163	205,997	42,093,060
4	India	4,036,858	4,859,156	414	8,895,600
4	Kazakhstan	22,073	7,940	7,782	22,230
4	Lao People's DR	4,416	-	-	4,416
4	Myanmar	162,008	-	-	162,008
4	Norway	237,582	157,659	71,345	323,896
4	Paraguay	365,464	1,081,400	-	1,446,864
4	Republic of Moldova	27,659	16,980	11,161	33,478
4	Serbia	210,950	6,705	13,513	204,142
4	Togo	32	1,554	26	1,560
4	Uganda	58,958	54,408	-	113,365
4	United States of America	28,835,985	7,528,093	113,778	36,250,300
4	Uzbekistan	11,760	-	-	11,760
4	Zambia	14,421	9,698	8,519	15,600

Table 38 SBM clusters summary

SBM Average Tons by cluster 2010/2011							
Cluster ID	**cluster size**	**cluster size %**	**Demand 10/11**	**Exports 10/11**	**Imports 10/11**	**Production 10/11**	**Archetype Associated**
1	28	16%	0	0	0	0	No SBM activity
2	62	35%	1,119,070	38,845	735,769	422,146	Import to feed (I2F) - (P2F)
3	67	38%	177,654	102,674	250,837	29,490	Import to feed (I2F) - (I2E)
4	19	11%	4,863,871	2,916,179	24,558	7,755,493	Produce to feed (P2F) - (P2E)

Table 39 Meat clusters

Cluster ID	Country	Demand 10/11	Exports 10/11	Imports 10/11	Production 10/11
	Meat Tons 2010/2011				
1	Argentina	1,769,143	264,257	73,027	1,960,373
1	Austria	744,366	372,212	306,660	809,918
1	Belarus	621,794	171,317	104,711	688,400
1	Belgium	635,049	1,374,458	385,509	1,623,997
1	Bolivia (Plurinational State of)	465,581	1,802	1,447	465,937
1	Brazil	10,125,328	4,640,329	2,777	14,762,880
1	Canada	2,227,671	1,374,036	435,618	3,166,089
1	Chile	984,728	247,606	93,828	1,138,506
1	Costa Rica	148,649	11,548	8,570	151,628
1	Denmark	251,092	1,852,466	218,833	1,884,725
1	Finland	293,450	58,135	50,120	301,465
1	France	3,688,466	1,259,772	983,784	3,964,454
1	Germany	6,022,786	2,962,915	2,032,078	6,953,623
1	Hungary	677,570	396,416	241,745	832,241
1	India	2,561,457	8,936	1,793	2,568,600
1	Ireland	245,879	258,853	162,501	342,231
1	Israel	569,785	10,583	778	579,589
1	Kenya	35,989	2,580	202	38,367
1	Lao PD Republic	82,046	-	-	82,046
1	Netherlands	860,257	2,311,743	965,541	2,206,458
1	Pakistan	741,426	1,566	1,052	741,940
1	Poland	2,907,562	900,614	614,741	3,193,435
1	Spain	3,490,275	1,423,568	308,042	4,605,801
1	Sri Lanka	102,235	3,669	1,632	104,272
1	Thailand	1,690,052	497,079	1,887	2,185,244
1	Tunisia	154,380	4,078	2,986	155,472
1	Turkey	1,339,022	203,810	1,063	1,541,769
1	United States of America	24,829,147	5,578,249	461,305	29,946,092
2	Algeria	278,275	27	1,741	276,560
2	Australia	1,474,597	70,810	218,580	1,326,827
2	Bangladesh	205,558	-	58	205,500
2	Barbados	20,351	617	3,638	17,330
2	Burkina Faso	69,504	7	238	69,272
2	Cambodia	135,913	-	313	135,600
2	Central African Republic	24,146	-	266	23,880
2	Chad	6,025	-	159	5,866
2	China, mainland	65,312,464	819,084	945,547	65,186,000
2	China, Taiwan Province of	1,677,180	9,146	167,496	1,518,830
2	Colombia	1,346,133	5,096	73,765	1,277,464
2	Cyprus	92,190	7,527	16,091	83,626
2	Dominican Republic	458,378	1,760	35,224	424,914
2	Ecuador	540,216	363	10,779	529,800
2	El Salvador	127,904	11,630	24,642	114,892
2	Ethiopia	58,464	16	109	58,370

Cluster ID	Country	Demand 10/11	Exports 10/11	Imports 10/11	Production 10/11
	Meat Tons 2010/2011				
2	Fiji	23,566	279	1,668	22,177
2	Iceland	13,918	87	831	13,174
2	Indonesia	2,339,092	354	1,612	2,337,834
2	Iran	1,917,691	26,390	47,240	1,896,841
2	Italy	3,584,655	436,708	1,189,312	2,832,051
2	Jordan	221,540	21,011	53,390	189,161
2	Lebanon	104,005	5,051	20,792	88,265
2	Libya	120,710	-	110	120,600
2	Madagascar	127,960	2	742	127,219
2	Malawi	60,119	7	190	59,936
2	Malaysia	1,534,528	28,645	62,601	1,500,572
2	Mali	45,199	84	1,318	43,965
2	Mauritius	51,827	165	4,288	47,705
2	Morocco	632,299	368	3,280	629,388
2	Myanmar	1,760,262	-	2,365	1,757,897
2	Nepal	44,188	177	343	44,022
2	New Zealand	238,033	6,853	43,556	201,330
2	Norway	215,715	4,733	5,935	214,513
2	Paraguay	204,784	740	3,683	201,840
2	Peru	1,193,034	3,092	27,201	1,168,925
2	Philippines	2,747,277	11,664	202,442	2,556,499
2	Portugal	778,740	79,810	190,401	668,149
2	Romania	1,001,516	90,045	311,885	779,676
2	Rwanda	10,333	-	216	10,118
2	Senegal	62,213	41	766	61,488
2	Serbia	369,879	11,975	18,551	363,303
2	Somalia	3,675	-	48	3,628
2	Syrian Arab Republic	187,608	5,109	7,986	184,731
2	Uganda	178,214	181	1,119	177,275
2	Ukraine	1,806,966	47,363	209,829	1,644,500
2	Tanzania	72,794	288	2,451	70,630
2	Uruguay	117,011	4,216	23,562	97,664
2	Zambia	66,641	110	1,011	65,740
3	Afghanistan	71,598	-	44,798	26,800
3	Albania	74,121	8	44,279	29,850
3	Angola	428,918	46	335,274	93,690
3	Antigua and Barbuda	8,988	20	8,438	570
3	Armenia	67,117	285	53,051	14,350
3	Bahamas	42,058	-	35,103	6,955
3	Bermuda	6,030	-	5,848	182
3	Bulgaria	351,923	53,196	228,277	176,843
3	Cabo Verde	20,826	-	11,701	9,125
3	China, Macao SAR	52,091	11	41,073	11,029
3	Congo	69,482	1	61,238	8,245

Table 39 Meat clusters (continued)

Cluster ID	Country	Meat Tons 2010/2011 Demand 10/11	Exports 10/11	Imports 10/11	Production 10/11
3	Cuba	407,619	-	198,864	208,755
3	Dominica	5,168	-	4,408	760
3	French Polynesia	20,224	-	18,178	2,047
3	Gabon	73,502	-	66,578	6,924
3	Gambia	7,246	-	5,451	1,795
3	Georgia	81,940	804	58,744	24,000
3	Ghana	199,634	-	141,966	57,669
3	Greece	524,354	29,708	325,442	228,620
3	Grenada	7,900	-	6,940	960
3	Guinea	18,853	52	9,933	8,973
3	Haiti	111,976	-	67,866	44,110
3	Iraq	387,269	-	317,285	69,984
3	Japan	5,053,062	8,713	2,384,434	2,677,341
3	Kuwait	210,599	803	171,952	39,450
3	Kyrgyzstan	113,894	83	92,591	21,385
3	Latvia	127,718	18,167	85,299	60,586
3	Lesotho	13,755	-	8,500	5,255
3	Liberia	40,987	-	20,147	20,840
3	Malta	28,731	22	16,900	11,853
3	Mauritania	13,827	14	9,349	4,492
3	Mongolia	5,618	-	4,972	646
3	Montenegro	40,511	1,755	35,595	6,671
3	Netherlands Antilles	21,226	-	20,643	583
3	New Caledonia	18,962	13	15,785	3,190
3	Saint Kitts and Nevis	4,588	-	4,359	229
3	Saint Lucia	15,362	1	12,435	2,928
3	St Vincent	9,294	-	8,364	930
3	Samoa	14,779	-	10,695	4,084
3	Sao Tome and Principe	2,645	-	1,764	881
3	Saudi Arabia	1,285,377	25,919	738,295	573,000
3	Slovakia	280,522	62,571	198,552	144,540
3	Solomon Islands	4,782	-	2,144	2,638
3	Suriname	33,628	743	21,076	13,296
3	Tajikistan	34,233	-	30,021	4,212
4	Benin	110,881	54,508	137,568	27,821
4	China, Hong Kong SAR	1,104,550	978,517	1,930,744	152,323
4	Djibouti	1,446	-	1,446	-
4	Luxembourg	33,822	6,482	28,511	11,793
4	Maldives	7,143	-	7,143	-
4	The FYR of Macedonia	55,695	6,833	51,947	10,581
4	United Arab Emirates	346,999	22,577	328,476	41,100
5	Azerbaijan	88,785	231	20,217	68,798
5	Belize	19,064	1	3,912	15,153
5	Bosnia and Herzegovina	82,018	12,038	37,468	56,587
5	Botswana	11,569	120	5,131	6,558

Cluster ID	Country	Meat Tons 2010/2011 Demand 10/11	Exports 10/11	Imports 10/11	Production 10/11
5	Brunei Darussalam	26,817	1	4,695	22,124
5	Cameroon	110,039	2	2,640	107,400
5	Côte d'Ivoire	56,539	46	15,249	41,336
5	Croatia	220,177	19,586	87,353	152,410
5	Czech Republic	731,651	118,905	382,063	468,494
5	Democratic PD of Korea	155,025	-	2,325	152,700
5	Egypt	942,955	2,262	81,722	863,495
5	Estonia	85,569	37,526	58,326	64,769
5	Guatemala	332,213	23,086	108,777	246,522
5	Guinea-Bissau	17,563	-	1,426	16,138
5	Guyana	28,756	6	2,715	26,047
5	Honduras	215,926	2,375	51,914	166,386
5	Jamaica	162,254	566	54,196	108,623
5	Kazakhstan	483,380	722	171,827	312,275
5	Kiribati	2,625	-	969	1,657
5	Lithuania	217,038	47,022	111,038	153,022
5	Mexico	5,144,411	113,957	1,305,217	3,953,152
5	Mozambique	142,446	-	13,247	129,199
5	Namibia	25,999	641	10,275	16,365
5	Nicaragua	124,319	471	13,393	111,397
5	Niger	18,369	-	414	17,956
5	Nigeria	555,163	-	23,663	531,500
5	Palestine	72,300	350	9,700	62,950
5	Panama	185,910	1,725	25,898	161,737
5	Republic of Korea	2,276,807	24,645	658,440	1,643,012
5	Republic of Moldova	121,064	154	19,338	101,880
5	Russian Federation	6,513,918	49,116	1,454,335	5,108,699
5	Sierra Leone	26,424	-	9,886	16,538
5	Slovenia	129,688	40,980	69,861	100,807
5	South Africa	1,987,185	16,920	314,900	1,689,205
5	Sudan (former)	41,811	-	2,811	39,000
5	Swaziland	7,920	8	1,028	6,900
5	Sweden	513,535	53,088	191,637	374,986
5	Switzerland	391,949	1,748	73,723	319,974
5	Timor-Leste	15,801	-	5,273	10,528
5	Togo	49,198	1,376	11,633	38,940
5	Trinidad and Tobago	94,039	1,283	27,190	68,132
5	Turkmenistan	23,870	-	3,820	20,050
5	United Kingdom	3,656,014	537,021	1,846,735	2,346,300
5	Uzbekistan	62,283	-	10,933	51,350
5	Vanuatu	6,481	9	2,160	4,330
5	Venezuela	1,513,169	-	220,456	1,292,713
5	Viet Nam	4,279,547	8,907	655,446	3,633,008
5	Yemen	240,520	16	93,634	146,902
5	Zimbabwe	119,827	6	25,577	94,256

Table 40 Meat clusters summary

Meat Average Tons by cluster 2010/2011							
Cluster ID	**cluster size**	**cluster size %**	**Demand 10/11**	**Exports 10/11**	**Imports 10/11**	**Production 10/11**	**Archetype Associated**
1	28	16%	2,438,042	935,450	266,508	3,106,984	Produce to food (P2Fd) - (P2E)
2	49	28%	1,911,496	34,931	80,395	1,866,031	Produce to food (P2Fd)
3	45	25%	231,398	4,510	132,991	102,917	Import to food (I2Fd) - (P2Fd)
4	7	4%	237,219	152,702	355,119	34,802	Import to food (I2Fd) - (I2E)
5	49	28%	659,794	22,794	169,481	513,107	Produce to food (P2Fd) - (I2Fd)

Table 41 Value chain cluster

		Value chain Tons 2010/2011					
Cluster ID	Country	Meat demand	Meat production	SBM demand	SBM production	Soybeans Processing	Soybeans production
1	China, mainland	65,312,464	65,186,000	41,587,894	42,093,060	51,333,000	14,784,000
1	China, Taiwan	1,677,180	1,518,830	1,864,940	1,805,940	2,286,000	155
1	Israel	569,785	579,589	396,051	306,320	382,900	-
1	Costa Rica	148,649	151,628	205,718	185,350	234,700	-
1	Netherlands	860,257	2,206,458	2,466,135	1,798,950	2,362,000	-
1	Norway	215,715	214,513	237,582	323,896	404,870	-
1	Portugal	778,740	668,149	719,341	548,300	689,000	-
1	Tunisia	154,380	155,472	359,378	309,300	394,000	-
1	Turkey	1,339,022	1,541,769	1,684,761	1,218,197	1,522,746	94,400
2	Bosnia Herzegovina	82,018	56,587	79,026	31,005	39,750	7,378
2	Egypt	942,955	863,495	2,101,247	1,379,320	1,724,150	36,564
2	Germany	6,022,786	6,953,623	4,535,179	2,388,150	2,994,600	1,500
2	Greece	524,354	228,620	519,176	213,453	273,657	4,150
2	Indonesia	2,339,092	2,337,834	4,747,911	1,844,196	2,305,245	875,435
2	Japan	5,053,062	2,677,341	3,921,193	1,725,991	2,270,450	220,650
2	Malaysia	1,534,528	1,500,572	1,496,926	482,212	610,395	-
2	Mexico	5,144,411	3,953,152	2,810,680	1,808,000	2,260,000	186,450
2	Nepal	44,188	44,022	119,277	52,591	67,424	25,180
2	Republic of Korea	2,276,807	1,643,012	2,256,697	672,200	907,850	117,370
2	Saudi Arabia	1,285,377	573,000	878,889	346,610	433,262	-
2	Spain	3,490,275	4,605,801	4,471,465	2,520,890	3,191,000	1,756
2	Syrian Arab Republic	187,608	184,731	805,497	328,350	420,950	2,686
2	Thailand	1,690,052	2,185,244	3,622,344	1,115,500	1,430,550	176,604
2	United Kingdom	3,656,014	2,346,300	2,545,653	509,250	686,050	-
3	Belgium	635,049	1,623,997	815,172	42,350	53,410	-
3	Chile	984,728	1,138,506	581,349	69,451	86,814	-
3	Cuba	407,619	208,755	354,895	68,289	97,555	-
3	Denmark	251,092	1,884,725	1,515,149	52,500	67,783	-
3	Iran	1,917,691	1,896,841	2,371,218	681,375	862,500	166,349
3	Morocco	632,299	629,388	576,268	92,827	116,034	1,000
3	Australia	1,474,597	1,326,827	546,216	31,428	39,285	44,675
3	Austria	744,366	809,918	434,966	17,200	21,500	101,961
3	Bulgaria	351,923	176,843	104,031	6,586	8,443	1,164
3	Colombia	1,346,133	1,277,464	1,213,686	250,285	357,550	64,822
3	Croatia	220,177	152,410	223,019	79,850	98,900	150,426
3	Czech Republic	731,651	468,494	482,242	28,650	36,300	17,017
3	Ecuador	540,216	529,800	613,471	48,472	64,629	70,500
3	France	3,688,466	3,964,454	3,858,790	416,450	557,800	129,635
3	Guatemala	332,213	246,522	316,275	29,448	39,264	37,000
3	Honduras	215,926	166,386	167,752	3,823	4,779	2,072
3	Hungary	677,570	832,241	630,998	46,250	58,050	90,198
3	Italy	3,584,655	2,832,051	3,326,972	1,251,450	1,579,650	558,569
3	Nicaragua	124,319	111,397	67,012	3,371	4,213	4,518
3	Peru	1,193,034	1,168,925	997,676	2,744	3,430	2,764
3	Philippines	2,747,277	2,556,499	1,571,179	57,454	71,818	748
3	Poland	2,907,562	3,193,435	1,883,313	12,595	15,943	290
3	Romania	1,001,516	779,676	394,985	25,965	32,867	146,288
3	Slovakia	280,522	144,540	133,660	21,464	27,876	30,483
3	South Africa	1,987,185	1,689,205	1,128,434	187,259	234,074	638,000
3	Sri Lanka	102,235	104,272	140,358	3,285	5,476	5,680
3	Switzerland	391,949	319,974	307,407	20,500	25,750	3,188
3	Venezuela	1,513,169	1,292,713	1,213,097	132,562	172,158	52,351
3	Viet Nam	4,279,547	3,633,008	2,831,521	68,075	85,094	282,569
4	Benin	110,881	27,821	2,828	8,522	10,653	11,000
4	Cambodia	135,913	135,600	68,293	50,625	62,500	135,596
4	Kazakhstan	483,380	312,275	22,073	22,230	29,250	123,495
4	Lao PD Republic	82,046	82,046	4,416	4,416	5,520	12,628
4	Nigeria	555,163	531,500	40,449	16,000	20,000	424,430
4	Republic of Moldova	121,064	101,880	27,659	33,478	44,050	94,684
4	Ukraine	1,806,966	1,644,500	321,637	278,160	366,000	1,972,300
4	Zambia	66,641	65,740	14,421	15,600	20,000	114,213
5	Argentina	1,769,143	1,960,373	2,966,730	28,858,630	37,082,250	50,778,068
5	Bolivia	465,581	465,937	168,426	1,229,561	1,672,500	1,777,043
5	Brazil	10,125,328	14,762,880	13,680,255	27,660,000	35,659,750	71,785,892
5	DPR of Korea	155,025	152,700	232,106	200,429	256,960	350,000
5	India	2,561,457	2,568,600	4,036,858	8,895,600	11,119,500	12,475,000
5	Paraguay	204,784	201,840	365,464	1,446,864	1,831,473	7,885,114
5	USA	24,829,147	29,946,092	28,835,985	36,250,300	45,850,000	87,398,692
5	Serbia	369,879	363,303	210,950	204,142	306,500	490,853
5	Myanmar	1,760,262	1,757,897	162,008	162,008	202,510	247,363
5	Russian Federation	6,513,918	5,108,699	1,544,008	1,088,322	1,575,750	1,489,190
5	Uganda	178,214	177,275	58,958	113,365	143,500	197,370
6	Algeria	278,275	276,560	1,036,072	-	-	-
6	Angola	428,918	93,690	593	-	-	-
6	Armenia	67,117	14,350	9,387	-	-	-
6	Azerbaijan	88,785	68,798	52,474	-	-	5
6	Barbados	20,351	17,330	19,257	19,369	24,211	-
6	Belarus	621,794	688,400	298,721	-	-	-
6	Botswana	11,569	6,558	6,860	-	-	-
6	Brunei Darussalam	26,817	22,124	1,612	-	-	-
6	Cabo Verde	20,826	9,125	1,339	-	-	-
6	China, Hong Kong	1,104,550	152,323	11,365	-	-	-
6	Congo	69,482	8,245	2,908	-	-	-
6	Cyprus	92,190	83,626	117,547	-	-	-
6	Dominican Republic	458,378	424,914	398,699	3,537	4,421	-
6	Estonia	85,569	64,769	25,819	-	-	-
6	Fiji	23,566	22,177	7,902	-	-	-
6	Finland	293,450	301,465	162,738	6,634	8,293	-

Table 41 Value chain clusters (continued)

Cluster ID	Country	Value chain Tons 2010/2011					
		Meat demand	Meat production	SBM demand	SBM production	Soybeans Processing	Soybeans production
6	French Polynesia	20,224	2,047	1,590	-	-	-
6	Guinea	18,853	8,973	457	-	-	-
6	Guyana	28,756	26,047	16,146	-	-	-
6	Iceland	13,918	13,174	15,868	-	-	-
6	Iraq	387,269	69,984	9,172	3,848	4,809	52
6	Ireland	245,879	342,231	385,477	3,476	4,400	-
6	Jamaica	162,254	108,623	69,622	262	327	-
6	Kuwait	210,599	39,450	69,281	59	74	-
6	Latvia	127,718	60,586	52,198	10,222	13,450	-
6	Lebanon	104,005	88,265	138,267	1,134	1,418	-
6	Libya	120,710	120,600	219,257	57	71	-
6	Lithuania	217,038	153,022	115,115	-	-	-
6	Luxembourg	33,822	11,793	14,414	112	140	-
6	Madagascar	127,960	127,219	2,197	-	-	42
6	Malta	28,731	11,853	17,154	-	-	-
6	Mauritius	51,827	47,705	40,686	-	-	-
6	Montenegro	40,511	6,671	709	-	-	-
6	Mozambique	142,446	129,199	69,686	-	-	-
6	Namibia	25,999	16,365	2,587	-	-	-
6	New Caledonia	18,962	3,190	2,942	-	-	-
6	New Zealand	238,033	201,330	105,109	-	-	-
6	Niger	18,369	17,956	322	-	-	-
6	Pakistan	741,426	741,940	351,610	-	-	70
6	Panama	185,910	161,737	178,507	-	-	91
6	Senegal	62,213	61,488	6,863	-	-	-
6	Sudan (former)	41,811	39,000	5,741	-	-	-
6	Suriname	33,628	13,296	10,169	-	-	16
6	Swaziland	7,920	6,900	3,400	-	-	-
6	Sweden	513,535	374,986	277,340	17,351	21,689	-
6	Tajikistan	34,233	4,212	2,713	-	-	18
6	Trinidad and Tobago	94,039	68,132	30,755	4,181	5,973	-
6	United Arab Emirates	346,999	41,100	130,272	4,740	6,000	-
6	Uzbekistan	62,283	51,350	11,760	11,760	14,700	-
6	Yemen	240,520	146,902	108,797	-	-	-
7	Afghanistan	71,598	26,800	-	-	-	-
7	Antigua and Barbuda	8,988	570	-	-	-	-
7	Bahamas	42,058	6,955	-	-	-	-
7	Bermuda	6,030	182	-	-	-	-
7	Central African Republic	24,146	23,880	-	-	-	-
7	Chad	6,025	5,866	-	-	-	-
7	China, Macao SAR	52,091	11,029	-	-	-	-
7	Djibouti	1,446	-	-	-	-	-
7	Dominica	5,168	760	-	-	-	-

Cluster ID	Country	Value chain Tons 2010/2011					
		Meat demand	Meat production	SBM demand	SBM production	Soybeans Processing	Soybeans production
7	Ghana	199,634	57,669	-	-	-	-
7	Grenada	7,900	960	505	-	-	-
7	Guinea-Bissau	17,563	16,138	-	-	-	-
7	Haiti	111,976	44,110	41	-	-	-
7	Kiribati	2,625	1,657	-	-	-	-
7	Lesotho	13,755	5,255	-	-	-	-
7	Maldives	7,143	-	-	-	-	-
7	Mauritania	13,827	4,492	-	-	-	-
7	Mongolia	5,618	646	45	-	-	-
7	Netherlands Antilles	21,226	583	-	-	-	-
7	Palestine	72,300	62,950	-	-	-	-
7	Saint Kitts and Nevis	4,588	229	-	-	-	-
7	Saint Lucia	15,362	2,928	-	-	-	-
7	Saint Vincent	9,294	930	-	-	-	-
7	Samoa	14,779	4,084	-	-	-	-
7	Sao Tome and Principe	2,645	881	-	-	-	-
7	Sierra Leone	26,424	16,538	-	-	-	-
7	Solomon Islands	4,782	2,638	-	-	-	-
7	Somalia	3,675	3,628	-	-	-	-
7	Timor-Leste	15,801	10,528	-	-	-	958
7	Turkmenistan	23,870	20,050	-	-	-	-
7	Vanuatu	6,481	4,330	-	-	-	-
8	Albania	74,121	29,850	18,261	394	512	550
8	Bangladesh	205,558	205,500	385,095	-	-	67,703
8	Belize	19,064	15,153	9,884	-	-	658
8	Burkina Faso	69,504	69,272	55	-	-	22,725
8	Cameroon	110,039	107,400	28,857	-	-	12,811
8	Côte d'Ivoire	56,539	41,336	12,013	-	-	879
8	El Salvador	127,904	114,892	151,053	-	-	4,556
8	Gabon	73,502	6,924	4,828	3,617	4,521	3,165
8	Georgia	81,940	24,000	5,391	-	-	1,431
8	Kenya	35,989	38,367	42,154	-	-	2,938
8	Kyrgyzstan	113,894	21,385	642	-	-	92
8	Liberia	40,987	20,840	1,500	-	-	3,050
8	Malawi	60,119	59,936	1,210	-	-	74,511
8	Mali	45,199	43,965	121	-	-	1,886
8	Rwanda	10,333	10,118	27	-	-	47,258
8	Slovenia	129,688	100,807	8,641	-	-	291
8	The FYR of Macedonia	55,695	10,581	26,592	-	-	770
8	Togo	49,198	38,940	32	1,560	1,950	1,550
8	Tanzania	72,794	70,630	431	-	-	2,800
8	Uruguay	117,011	97,664	37,224	274	366	1,915,000
9	Canada	2,227,671	3,166,089	1,985,799	1,056,600	1,337,075	4,295,800

Table 42 Value chain cluster summary

			Value chain Average Tons by cluster 2010/2011						
Cluster ID	**cluster size**	**cluster size %**	**Meat demand**	**Meat production**	**SBM demand**	**SBM production**	**Soybeans Processing**	**Soybeans production**	**Archetype Associated**
1	9	5%	7,895,132	8,024,712	5,502,422	5,398,813	6,623,246	1,653,173	Raw materials value adders
2	15	9%	2,284,902	2,010,222	2,327,410	1,027,848	1,307,689	110,381	Raw materials / intermediates value adders
3	29	17%	1,216,023	1,212,388	993,142	129,378	166,515	89,733	Intermediates value adders
4	8	5%	420,257	362,670	62,722	53,629	69,747	361,043	Disconnected value chain
5	11	6%	5,730,066	7,151,203	7,183,689	14,934,483	19,067,490	33,207,116	Vertically integrated
6	50	29%	168,800	111,435	92,389	1,735	2,199	6	Intermediates value adders / Final product consumers
7	31	18%	26,413	10,879	19	-	-	31	Final product consumers
8	20	11%	77,454	56,378	36,700	292	367	108,231	Intermediates value adders / Disconnected value chain
9	1	1%	2,227,671	3,166,089	1,985,799	1,056,600	1,337,075	4,295,800	Undefined

Table 43 Regression 1 results

Multiple R	0.93
R Square	0.86
Adjusted R Square	0.86
Standard Error	1.02
Observations	178

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-2.65	0.72	-3.67	0.00	-4.07	-1.22
Ln(Meat supply/demand)	1.15	0.07	15.80	0.00	1.00	1.29
LN(Meat exports)	0.03	0.02	1.45	0.15	-0.01	0.08
LN(Soybean production)	0.02	0.02	1.14	0.26	-0.02	0.06
LN(SBM production)	0.00	0.02	0.09	0.93	-0.04	0.05